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USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

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ACOUSTICS SPEECH AND SIGNAL PROCESSING

UDC 621.391.8

TRANSFORMATIONS ENSURING INVARIANCE OF DETECTION IN PRESENCE OF LOW-FREQUENCY NOISE WITH VARYING SPECTRAL PARAMETERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 12, Dec 85 (manuscript received 12 Nov 84) pp 3-10

[Article by V. I. Guziy, B. G. Marchenko and L. D. Protsenko]

[Abstract] Transformations of low-frequency noise with varying spectral parameters are proposed which will ensure invariance of signal detection, typical such noise being sea murmur and flicker noise in transitors as well as electric or magnetic field microfluctuations with a spectral density $S(\omega) = c^2/\omega^\alpha$ where c is a constant and $\alpha>0$ is a variable exponent. As a more accurate model of such a noise is selected a random process with spectral density $S_\delta(\omega) = c^2(\delta^2 + \omega^2)^{-1/2\alpha}$ with $\alpha \in (1,2)$ and $0<\delta<1$, assuming it has a zero mathematical expectation. With the concept of complete invariance $J(\delta)$ with respect to parameter defined as a minimax, two correlation meters are considered and their performance is evaluated in terms of output signal-to-noise ratio. The first device is one with Laguerre orthogonal first-order and second-order filters, particularly suitable for white input noise. The second device is one with a preceding CLR-series network. An analysis of the dependence of noise dispersion on parameter o indicates that both devices can be made to respond invariantly when parameters α and δ of the low-frequency input noise vary. Figures 1; references 9: 7 Russian, 2 Western (1 in Russian translation).

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UDC 621.391.266

METHOD OF CALCULATING OPTIMUM WINDOW FUNCTIONS

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 10 Apr 85) pp 45-49

[Article by M. N. Goldenberg, M. N. Polyak and A. A. Berestetskiy]

[Abstract] A method of calculating the optimum window functions for discrete Fourier transformation in digital detection systems is proposed, processing of a digital sequence by means of such a function being equivalent to digital filtration over a finite period of time. Finding the optimum window functions is accordingly reduced to optimizing the frequency characteristic of the equivalent nonrecursive basis filter and determing its coefficients which coincide with those functions. This can be done by any method of mathematical programming. For illustration, the method of least squares in a modified form is applied to the problem of optimum filter fitting for detection of a harmonic signal of unknown frequency submerged in a stationary white noise and the Chebyshev approximation according to the Remez algorithm is used for detection of a small-amplitude harmonic signal submerged in a large-amplitude harmonic interference with the frequencies of both unknown. Figures 2; references 4: 1 Russian, 3 Western (2 in Russian translation).

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UDC 621.391.26

ADAPTIVE INTERFERENCE COMPENSATOR WITH LATTICE FILTER AS DECORRELATOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 12, Dec 85 (manuscript received, after revision 11 May 85) pp 46-48

[Article by V. N. Lavrenyuk]

[Abstract] A lattice filter, a device tunable very fast with very few computations, is proposed as decorrelator for an adaptive interference compensator. An adaptation algorithm is considered which ensures the same time lag in the adjustment of each coefficient. The advantage of such a decorrelator is established on the basis of the dependence of the mean-square-signal detection error on the steady-state compensator parameters. Although the range of interference power to signal power ratio within which the mean-square signal detection error does not exceed its permissible limit widens as the decorrelator adaptation index is decreased, the latter must be sufficiently larger than zero so as to ensure adequate transient-state performance and fast enough convergence justifying the use of this instead of the simpler Widrow decorrelator. As a consequence of a large decorrelator adaptation index, there will be fluctuations of the decorrelator coefficients in the steady state so that an

additional mean-square signal detection error will arise. This error can be minimized by control of the decorrelator adaptation index according to the proposed algorithm. The compensator performance, moreover, will not significantly depend on the parameters of the reference signal. Figures 1; references 3: 1 Russian, 2 Western (1 in Russian translation).

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UDC 621.391

OPTIMIZATION OF IDENTIFICATION SYSTEM FOR MULTIDIMENSIONAL NORMAL SETS

Moscow RADIOTEKHNIKA in Russian No 12, Dec 85 (manuscript received 12 Apr 85) pp 8-11

[Article by Ya. A. Fomin and A. V. Savich]

[Abstract] Identification of random vector signals submerged in noise, as well as automatic recognition of speakers by their voices or automatic inspection and trouble-shooting of radioelectronic equipment, reduces essentially to the problem of determining to which of two classes S_1,S_2 with unknown mean-value vectors and known common covariant matrix does a sample consisting of n independent p-dimensional normally distributed readings belong. Replacement of the unknown mean-value vectors with their maximum-likelihood estimates is considered as the basis for arriving at the identification rule. For optimization of the identification process, an expression is derived for the probabilities of errors in indentification on the basis of adaptive samples and control samples. According to this expression, then, it becomes possible to determine the dimensions of each kind of samples which will allow minimizing the total number of readings necessary for ensuring the prescribed accuracy of identification with given dimension p of the criteria space and minimum Mahalanobis distance between the two classes S_1,S_2. An identifier structure for the special but common case of equidimensional adaptive and control samples is synthesized accordingly by statistical simulation, namely the vector of identifier parameters is found which will minimize some criterion and will satisfy given constraints on permissible values of parameters and probabilities of errors. Tables 1; references 8: 6 Russian, 2 Western (1 in Russian translation).

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UDC 681.335.2:681.84

NONLINEARITY REQUIREMENTS OF ANALOG-DIGITAL AND DIGITAL-ANALOG CONVERTERS EMPLOYED IN AUDIO SIGNAL PROCESSING AND TRANSMISSION SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85 (manuscript received 18 Jun 85) pp 28-31

[Article by O. B. Semenov]

[Abstract] Requirements are defined for the integral nonlinearity of analog-digital and digital-analog converters employed for sound reproduction, where the integral nonlinearity is defined as the greatest deviation of the real static transfer characteristic of the device, expressed as a fraction of the low-order bit, from the ideal stairstep characteristic that describes uniform quantization by level. Two approaches to defining the nonlinearity characteristics are described: one in which the objective is to minimize the coefficient of nonlinear distortion, and the other in which psychoacoustic factors are taken into account. The latter approach does not provide the potential possible coefficient of nonlinear distortion, which employs an important role in forming the user qualities of audio broadcasting equipment. Figures 4; tables 1; references 6: 3 Russian, 3 Western.

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UDC 621.391.2:519.216

DISTRIBUTION AND DISTRIBUTION MOMENTS OF SUM OF DIGITAL RANDOM SIGNALS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85
(manuscript received 27 May 85 after revision) pp 42-45

[Article by N. A. Bolshakov]

[Abstract] A numerical method is proposed for calculating the distribution of the sum of digital random signals employing the theory of Markov chains; the moments of the distribution are defined. The method, which can be used for manual or machine calculation, makes it possible to obtain results for an arbitrary or nonstationary outcome vector of the quantization of the input process. The method can be employed for approximate calculation of the distributions of sums of analog signals for a sufficiently large number of quantization thresholds for which the quantization outcome vector is close to the distribution of the input process. The formulas derived for the moments of the distributions can be used to assess the properties of these distributions as a function of the properties of the quantizer. References: 2 Russian.

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UDC 621.391.019.4

COMPARISON OF DIGITAL ALGORITHMS FOR ADAPTIVE PROCESSING OF SIGNALS IN SYSTEMS WITH PREFORMING OF BEAMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
(manuscript received 28 Dec 83) pp 2378-2386

[Article by L. I. Byalyy and S. M. Yelistratov]

[Abstract] A discussion is presented of adaptation algorithms, optimal in terms of the criterion of the minimum mean output power, implementing direct and recurrence methods in adaptive systems with preforming of beams (ASPEL) in which auxiliary beams are oriented in the direction of the sources of interfering signals whose coordinates are entered into the system from outside. The direct method of adaptation is based on the direct solution of the sampling analogue of the Wiener-Hopf equation, and in the recurrence method the weighting factors are refined as information is sampled and accumulated. The simplest case of the total separation of interfering signals by the auxiliary beams is considered. Estimates are made of the size of the sample and of the number of computing operations required for various algorithms. For the direct method the following algorithms are discussed: the precise algorithm; diagonal approximation of the sampling covariance matrix; expansion of the $\hat{R}^{-1}$ matrix into a Taylor series; and the regularized algorithm. A gradient adaptation algorithm utilizing correlation feedback represents the recurrence method. It is concluded that of the adaptation algorithms discussed, the smallest sample is required for adaptation algorithms for direct solution of the Wiener-Hopf equation. The number of computing operations necessary is proportional to the cube of the number of auxiliary channels. The number of computations can be reduced under certain conditions by utilizing a priori information on the diagonality of the covariance matrix and using an approximate adaptation algorithm but this increases the size of the sample. The gradient adaptation algorithm requires a larger sample but fewer computations under certain conditions than the direct method algorithms. Figures 4; references 11: 7 Russian, 4 Western.

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CSO: 1860/187

UDC 523.164.4

ABSOLUTE FLUX SCALE FOR RADIO ASTRONOMY: REVIEW

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 1, Jan 86 (manuscript received 16 May 85) pp 3-27

[Article by V. P. Ivanov and K. S. Stankevich, Scientific Research Institute of Radiophysics]

[Abstract] Several radiation flux intensity scales have been proposed since 1963 for absolute measurements in radio astronomy, scales which make use of secondary standards for more precise calibration of relative scales and facilitating measurements by the "artificial moon" method. As secondary standards are used medium-intensity sources which meet all the requirements that the primary standards used since 1957 do. These new scales are the Conway-Kellermann-Long scale (1963) with Cassiopeia A as primary standard, the Baars-Mezger-Wendker scale (1965) with Cassiopeia A, Taurus A, Cygnus A, Virgo A as nonthermal centimetric-wave standards, the Kellermann-Pauliny.Toth-Williams scale (1969) with Cassiopeia A, Virgo A as primary standards and Hydra A, Hercules A as secondary standards, the Wills scale with Cassiopeia A as primary standard but with much less reliance on "artificial moon" data than the Kellermann-Pauliny.Toth-Williams scale, the Baars-Hartsuijker scale (1972), the Baars-Genzel-Pauliny.Toth-Witzel scale (1977), and the Altunin-Ivanov-Stankevich scale (1977). Secondary standards are selected from among 14 medium-intensity sources, the criteria for the Altunin-Ivanov-Stankevich scale having been constancy of the flux intensity, accuracy of spectrum measured relative to the primary standard, sufficiently high intensity at assigned frequencies, angular dimensions not exceeding 1', and degree of linear polarization not exceeding 10%. Since in all the scales Cassiopeia A plays a principal role but its radiation flux intensity is decreasing, presumably by 1.3% per annum at all frequencies, for the Altunin-Ivanov-Stankevich scale its spectrum has been measured by the "artificial moon" method over a short period of time only and over the 0.5-10 GHz frequency range only. Measurement by another method, the method of relative spectra ensuring a better accuracy over a wide range decametric to millimetric wavelengths was proposed by V. P. Ivanov (1982). Also replacement of the quite variable Cassiopeia A as primary standard, particularly by Cygnus A, was proposed for the most widely used Baars-Genzel-Pauliny.Toth-Witzel scale. On the basis of available data, absolute measurements made by the "artificial moon" method can be now and have been compared with those made by the method of standard dipoles and those made by the method of standard horns using horn scale 1, 2, or 3, also with those made according to predecessor scales. Figures 6; tables 7; references 64: 16 Russian, 48 Western.

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CSO: 1860/207

UDC 621.371.537.86

SCATTERING OF EXTRA-LOW-FREQUENCY RADIO WAVES BY GLOBAL INHOMOGENEITIES IN EARTH-IONOSPHERE CAVITY

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian
Vol 29, No 1, Jan 86 (manuscript received 25 Jun 84) pp 33-40

[Article by A. P. Nikolayenko, Institute of Radiophysics and Electronics, UkSSR Academy of Sciences]

[Abstract] The electrodynamic problem of radio wave propagation through an isotropic nonhomogeneous resonator is formulated for extra-low-frequency waves propagating through the earth-ionosphere cavity. Into account is taken scattering not only by horizontal inhomogeneities in the lower ionosphere but also by global inhomogeneities such as day-night terminator and polar singularity. Assuming that the earth-ionosphere resonator cavity has an ideally conducting lower boundary and is excited by a vertical electric point-dipole, the corresponding Stratton-Chu integral equation equivalent to the Maxwell field equations is solved in the Born approximation. Asymptotic representations are used for regions far from sender and receiver as well as from their antipodes, while Legendre functions are used for regions around the singular points. Three models of global scatterers are considered (1. smooth scatterer with 45° slope angle, 2. sharp scatterer, 3. polar singularity) and three possible orientations of the propagation path relative to the scatterer line are considered (1. "perpendicular" with the arc from sender to receiver at 90° to the terminator line, 2. "parallel" with the terminator equidistant from sender and receiver, 3. "oblique", namely "parallel" path rotated through a 45° angle). The maximum perturbation has in all calculations been normalized to unity. The results indicate weak scattering of extra-low-frequency radio waves by global inhomogeneities, which validates application of the Born perturbation theory to this case but requires high-precision detectors. The author thanks M. P. Bazarov for several helpful comments contributing to a better presentation. Figures 4; references 12: 8 Russian, 4 Western (2 in Russian translation).

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UDC 551.510.535:621.396.238

DEPENDENCE OF CROSS-SECTION FOR FORESHORTENING SCATTERING OF ULTRASHORT WAVES BY SMALL-SCALE ARTIFICIAL INHOMOGENEITIES ON CONDITION OF IONOSPHERE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 1, Jan 86 (manuscript received 6 Mar 85) pp 115-117

[Article by V. A. Alimov, A. V. Korovin, A. M. Nasyrov, V. P. Uryadov and N. N. Yagnov, Kazan State University]

[Abstract] A study of small-scale artificial ionospheric turbulence was made, for the purpose of determining the dependence of the cross-section for foreshortening scattering of ultrashort waves on the altitude of the perturbation region and on the fluctuation spectrum of electron concentration. Measurements and analysis of experimental data indicate that the cross-section can increase and then decrease as the perturbation region enters and leaves the region of specular scattering, with the thickness of the former and the slope angle of the latter increasing during penetration. The fluctuation intensity increases at the same time, evidently owing to a lowering of the threshold power of turbulence excitation. The experimental data fit an inverse-square relation $\sigma \propto k^{-2}$ between cross-section for scattering σ and argument $k = \frac{4\pi f}{c} \sin 1/2\, \theta_s$ (f- frequency of waves, c- velocity of waves, θ_s-scattering angle) of the fluctuation spectrum rather than the inverse-cube relation according to the theory of thermal parametric instability. For obtaining the necessary data on the true spectrum of small-scale artificial ionospheric turbulence across the geomagnetic field are, accordingly, needed simultaneous and relatively fast measurements within the given frequency range at territorially diverse points where the conditions for optimum reception of foreshorteningly scattered signals prevail. The authors thank S. A. Metelev and V. L. Frolov for supplying the experimental data. Figures 2; references 14: 9 Russian, 5 Western.

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DETECTION OF SIGNALS SUBMERGED IN INTERFERENCE BY RADAR WITH SYNTHESIZED APERTURE

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 11 Sep 85) pp 11-14

[Article by S. S. Vaulin and L. G. Dorosinskiy]

[Abstract] An algorithm of optimum detection is constructed for one range channel of an airborne radar with synthesized aperture and a weak signal submerged in strong interference after reflection by a target surface with small

effective scattering cross-section. The algorithm is based on repetitive probing with a linear-frequency-modulated signal in a space with N interference sources in the presence of noise. The efficiency of this algorithm is evaluated in terms of correct-detection probability and false-alarm probability, taking into account a lowering of the signal-to-noise ratio threshold by the interference. The detection characteristics can be improved by more accurate measurement of the interference coordinates. Figures 4; references: 5 Russian.

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UDC 621.396.962

COMPENSATION OF ANGLE MEASUREMENT ERRORS CAUSED BY DISTORTIONS OF WAVE PHASE FRONT

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received 15 Jul 85) pp 14-17

[Article by G. G. Dzhavadov]

[Abstract] The effect of "angle noise" on the accuracy of measurement of angular coordinates by a radar is analyzed, this noise being generated by interference of forward and echo waves which results in distortions and fluctuations of the wave phase front. The dependence of angle measurement errors on that angle noise appearing as a "wandering" reflection center is evaluated on the basis of the "dumb-bell" radiator model of a radar target, the scattering indicatrix of such a reflector being analogous to the radiation pattern of an Adcock antenna and depending on the space angle about the normal to the base. Since increasing the interference immunity of the tracking system is difficult and not always feasible, error compensation is often necessary. Two-frequency probing and subsequent complex processing of angle data, with error compensation, is shown not to require that the two frequencies lie in different wave bands and to be implementable even in the case of a small frequency mismatch between the carriers. The algorithm of data processing for determination of angular coordinates is found to be in this case very little sensitive to distortions of the wave phase front. References: 5 Russian.

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UDC 621.371:550.388.2

EFFECT OF AURORAL LAYER ON AMPLITUDE OF SIGNALS TRAVELING OVER LONG DISTANCES

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 4 Apr 85) pp 85-87

[Article by V. A. Alebastrov, V. I. Bocharov, Ye. M. Zhulina, P. V. Kishcha and V. I. Kubov]

[Abstract] Six sky wave channels 6,500-10,300 km long were probed with obliquely incident signals in the 8-20 MHz frequency band during autumn and winter months, the period of high solar activity. Four of these channels were passing through an auroral absorption layer between fixed 60° and 78° latitudes. The data have been analyzed for the attenuating effect of auroral absorption on the signal. Measurements were made during each event in local time at four absorption points within the auroral layer. The readings have been compared with theoretical calculations, also without auroral absorption but with refractive scattering included. The results indicate that auroral absorption is dominant during the night and comparable with regular absorption during the day. Local absorption at various latitudes was subsequently estimated, with the auroral layer tentatively assumed to consist of 5° wide sublayers depending on the absorption intensity. Solution of the corresponding system of six simultaneous equations has yielded such estimates on the basis of a single passage through the lower ionosphere by an obliquely incident wave. Figures 2; tables 1; references 4: 3 Russian, 1 Western.

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SPACE CORRELATION CHARACTERISTICS OF RANDOMLY ANISOTROPIC NOISE FIELDS

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86 (manuscript received 22 Jan 85) pp 90-94

[Article by S. D. Vorobyev]

[Abstract] A noisy wave field with a random angular density of fluctuation noise intensity additively superposed on the regular angular intensity density is considered and, for the case of a plane field, the space cross-correlation between two observation points a distance d apart at coinciding instants of time is determined under three simplifying assumptions, firstly, the field in quasi-monochromatic. Secondly, the distances from these two points to the noise sources are sufficiently larger than the wavelength to make the contribution of nonuniform waves negligible. Thirdly, the field is noncoherent so that its components at each point are additive with respect to energy. The space correlation coefficient R(d) is represented as a complex quantity with direct and quadrature components for calculation of its Gaussian probability

density. The result reveals that the effect of random anisotropy on the cross-correlation is determined here not only by the base length d and the sector angle but also by the correlation interval of the angular noise intensity density and the ratio of dispersion to mean value of that density and does not depend on the autocorrelation of that density. A practical application of this is found in space-correlated detection of a noisy signal arriving from a point source together with background interference noise distributed over the radar scan angle. The author thanks V. I. Sizov for attentiveness and helpful discussions. Figures 2; references 6: 3 Russian, 3 Western.

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UDC 621.396.96/08:621.391.82

METHOD FOR CALCULATING TRACKING DISRUPTION PROBABILITY IN RADIO MEASUREMENT SYSTEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 1, Jan 86 (manuscript received after revision 15 Apr 85) pp 73-75

[Article by S. A. Moskalenko]

[Abstract] A method is proposed for calculating the probability of interruption of tracking using an approximate formula that estimates the probability of interruption during the period of arrival of the signal. The method does not involve matrix manipulation, and is based on the property of central symmetry of the matrix of transitional probabilities of states of a tracking sensor. The method takes into account the properties of the transitional state probability matrix within the selection zone of a first-order tracking sensor, and reduces the dimensionality of the probability of disruption of tracking. References: 5 Russian.

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UDC 621.396

RADIO IMAGING OF RADIANT OBJECTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 12, Dec 85 (manuscript received after revision 19 Mar 85) pp 63-66

[Article by I. Ya. Kremer and V. I. Kostylev]

[Abstract] A quasi-optimum algorithm of radio imaging large objects from the electromagnetic field they either emit or reflect is constructed, imaging understood to mean statistically estimating the energy brightness $B_e(\vec{R})$ of an object upon pickup of its intrinsic radiothermal radiation within a given frequency band $f_0 \pm 1/2\Delta f$ within a given time interval $(-1/2T, +1/2T)$ by an antenna of given size and shape in the presence of white space-time noise with a spectral density N_0. The algorithm is based on the principle of maximum likelihood and the method of regularization. With the object located within the range of the receiver antenna and the latter located in the coordinate plane, a random space-time signal generated by this antenna upon pickup of radiothermal radiation is shown to be a Gaussian one with zero mean value and complex correlation function. The energy spectrum of time-domain frequency components remains approximately constant so that the form of the time correlation function is completely determined by the frequency-time characteristics of the antenna and, therefore, is known. The quasi-optimum regularized estimate is then $\tilde{B}_e(\vec{R})_1 + (\Delta f N_0^2/4TS_{eff}^2V_P)\cdot V(\vec{R})$ ($V_P = \int_P d\vec{R}$ - size of region P containing the object within range of the antenna, S_{eff} - effective area of the antenna). Figures 1; references 5: 4 Russian, 1 Western (in Russian translation)

2415/5915
CSO: 1860/194

UDC 621.396.96:621.391.26

NONPARAMETRIC DETECTORS OF RADAR SIGNALS WITH RANDOMIZED DETECTION CRITERION

Moscow RADIOTEKHNIKA in Russian No 12, Dec 85
(manuscript received after revision 24 Apr 85) pp 11-13

[Article by Yu. N. Gorbunov]

[Abstract] In order to design nonparametric detectors, particularly marker detectors, for detection of signals appearing with interference of variable intensity, it is necessary to estimate the detection characteristics on the basis of only few available "reference" noise readings and with the detection criterion randomized for minimization of the false-alarm probability. Estimation of the detection characteristics under such conditions is examined for a signal which either remains constant or fluctuates from pulse to pulse in the presence of a Gaussian interference. The criterion a randomized nonparametric marker detector establishes is defined as a double summation of the unit-step function over azimuth and range readings respectively. With one of the respective thresholds randomized, the probability of false detection is calculated for an amplitude detector with a Rayleigh distribution of readings at the receiver output and the probability of correct detection is calculated for a linear detector with a Rayleigh-Rice distribution of readings at the receiver output. Randomization of one threshold is found to already reduce the detector loss, by allowing a more precise setting of the mean threshold level. References 4: 2 Russian, 2 Western.

2415/5915
CSO: 1860/195

UDC 621.396.6

DETECTION OF LARGE RADIATION SOURCE WITH UNKNOWN DISTRIBUTION OF ENERGY BRIGHTNESS IN GENERAL CASE

Moscow RADIOTEKHNIKA in Russian No 12, Dec 85 pp 13-15

[Annotation of article No 664 by N. Ya. Kremer and V. I. Kostylev deposited in Informsvyaz Central Institute of Scientific and Technical Information]

[Abstract] An algorithm is constructed for detecting a large source of a random electromagnetic field with completely unknown distribution of energy brightness in the presence of an additive Gaussian white space-time background noise, with minimum dispersion of the interference component in the output signal. The algorithm is constructed for the general case of a three-dimensional object in either the Fraunhofer region or the Fresnel region, with the two-dimensional antenna in the coordinate plane. The number of angular resolution elements covering the object is assumed to be much larger than the ratio of signal energy picked up during a correlation time interval to spectral noise density, with the possibility of the total useful energy picked up during the entire processing time appreciably exceeding the spectral noise density. This algorithm is compared with the optimum algorithm for detecting a large source with known distribution of energy brightness, in which case the reference function $G^2(g)$ is set equal to the angular density of mean radiation power $A^2(g)$ received from direction g by an antenna with unit area and the signal-to-noise ratio becomes maximum. References 1: Russian.

2415/5915
CSO: 1860/195

UDC 621.396.677.3

SELECTIVE RECONSTITUTION OF SPACE-TIME SPECTRA

Moscow RADIOTEKHNIKA in Russian No 12, Dec 85
(manuscript received after revision 11 Jun 85) pp 71-73

[Article by Ye. N. Voronin]

[Abstract] Determination of the radiation pattern of an antenna with electrical dimensions larger than 10λ (λ- wavelength) requires reconstitution of the wave field in the Fraunhofer region from readings of the wave field in the Fresnel region, measurements in the latter region being usually made with probes or by the holographic method inside anechoic or shielded chambers. For the purpose of facilitating this reconstitution, a relation is established which describes the resistive component of mutual impedance between antenna and probe in terms of radiation pattern parameters. This relation is derived with the aid of the Green function for free space, on the basis of the reciprocity theorem and the invariance property of scalar products with respect to

gradient components of vectors. This relation, applicable to any radio-frequency or audio-frequency transmitter-receiver antenna, allows selective reconstitution of the space-time spectra of uniform and nonuniform waves as well as correction of holograms recorded in the Fresnel region. The relation was used for reconstituting, by numerical simulation, the radiation pattern of a radio-frequency half-wavelength dipole from readings taken inside a shielded cylinder. The author thanks Ye. Ye. Nechayev for assisting in computer simulation. Figures 2; references: 6 Russian.

2415/5915
CSO: 1860/195

UDC 621.396.96

VARIANCE OF DEPOLARIZATION COEFFICIENT OF RADIOWAVES

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85
(manuscript received after revision 7 Jun 85) pp 80-81

[Article by A. S. Skryabin]

[Abstract] The mean square depolarization coefficient of radiowaves scattered by various types of ground surfaces were investigated theoretically and experimentally. Measurements were made from an aircraft over different types of ground employing a 3-cm CW radar. It was found that the variation coefficient for the depolarization coefficient is small for the same type of surface, which makes it possible to distinguish between different types of ground covers from the measured depolarization coefficient. Tables 2; references 5: 4 Russian, 1 Western.

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ELECTROMAGNETIC WAVE PROPAGATION ALONG FILIFORM SPIRAL

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85
(manuscript received after revision 4 May 85) pp 82-84

[Article by V. M. Bondar]

[Abstract] Formulas are derived for calculating the electromagnetic field components of a spiral line with arbitrary periodic form over a broad range of frequencies. The electromagnetic wave propagation conditions along the spiral are obtained by analyzing the dispersion equation, which is obtained for a filiform spiral from the boundary conditions on the surface of an ideal metal disregarding losses in the conductor. The behavior of the strength of the

axial component of the electrical field of a cylindrical filiform spiral is analyzed as an example. The formulas make it possible to calculate the strength of the electromagnetic fields in real flexible cables with complex conductor twisting. Analysis of the dispersion equation makes it possible to determine the conditions under which the electromagnetic wave propagates along the spiral, or is radiated radially. The formulas for a filiform circular cylindrical spiral agree completely with those cited in the literature. Figures 1; tables 1; references: 2 Russian.

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UDC 550.38+621.37

REFLECTING PROPERTIES OF LOWER POLAR IONOSPHERE AND CHARACTERISTICS OF EXCITATION AND PROPAGATION OF VERY LOW FREQUENCY WAVES AT HIGH LATITUDES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 12, Dec 85 (manuscript received 5 Feb 85) pp 1491-1504

[Article by G. F. Remenets and M. I. Beloglazov, Leningrad State University]

[Abstract] This article reviews studies published over approximately the past ten years that have obtained new or more accurate findings on the free electron content in the lower ionosphere at high latitudes. The sources of anomalous ionization of the lower ionosphere at high latitudes are characterized, and new findings on electron density measurement in the lower ionosphere obtained by various methods are presented. New findings on the very low frequency propagation in the polar region derived from transpolar experiments, local experiments involving magnetospheric VLF propagation, are discussed. Changes that have come about in research on high latitude VLF propagation over the past ten years are summarized. Figures 5; references 72: 31 Russian, 41 Western.

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SPACE-TIME CHARACTERISTICS OF FREQUENCY-SEPARATED CENTIMETER-BAND RADIO WAVES PROPAGATING OVER THE SEA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 12, Dec 85 (manuscript received 10 Nov 84) pp 1505-1509

[Article by L. M. Lobkova, A. I. Nadobenko, and N. I. Mishareva, Sevastopol Instrument Engineering Institute]

[Abstract] The space-time characteristics of radio signals in the 3-cm band propagating over the sea were investigated experimentally using a CW transmitter that emitted two continuous-wave signals at separate frequencies. The

frequency-time and space-frequency correlations were measured on a path 9.6 km long in the area of Sevastopol. The respective heights of the transmitting and receiving points above sea level were 4.5 and 24 m. It was found that the frequency correlation radii of centimeter-band signals propagating over the sea are smaller than the corresponding quantities measured over land. The smallest frequency correlation radius measured was 150 MHz. No correlation was observed between fluctuations of the amplitude of 8-mm and 3-cm signals. The space correlation radii with the antennas separated horizontally were 2-4 times greater than the corresponding values when the antennas were separated vertically. The same was found to be true for space-frequency separation of signals. A formula was derived for calculating the correlation of the amplitude fluctuations of centimeter-band signals as a function of the amount of frequency and space separation. Figures 4; tables 1; references 12: 8 Russian, 4 Western.

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POLARIZATION PROPERTIES OF RADIOTHERMAL EMISSION OF ROUGH SURFACES CONTAINING LARGE, STEEP IRREGULARITIES II. STATISTICALLY ROUGH SURFACES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 12, Dec 85 (manuscript received 13 Jul 84) pp 1510-1515

[Article by V. M. Simonova and Yu. K. Shestopalov, Omsk Institute of Rail Transport Engineers]

[Abstract] A method is proposed for accounting for shadowing of a statistically rough surface when investigating radiothermal emission properties. The probability density that assigns the slope distribution is equivalent to the probability density of the first derivatives with respect to mutually perpendicular directions that are ordinarily employed. The results of numerical calculations using the method are presented, and the agreement between the findings and analogous calculations using other methods of accounting for shadowing is examined. The average surface slope for which total depolarization of radiothermal emission occurs is found to depend little upon the permittivity. The proposed method makes it possible to investigate the influence of shadowing on the reflecting and radiating properties of rough surfaces for simulation as well as statistical descriptions of surfaces. Figures 3; references: 6 Russian.

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ANTENNA SYNTHESIS FOR ASSIGNED RADIATION PATTERN AND EXCITATION FUNCTION ON PART OF APERTURE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 12, Dec 85 (manuscript received 21 January 85) pp 1602-1608

[Article by V. I. Korochentsev and B. A. Salnikov]

[Abstract] The synthesis of an antenna is investigated for the case in which the complex radiation pattern and complex excitation function on a part of the antenna aperture are assigned. The case of a cylindrical antenna whose field is independent of the z coordinate is examined. The problem is solved by an approximation method developed previously by the authors. The excitation functions of antennas with wave radius of 10 are calculated as an example to illustrate the proposed synthesis method. The method can be used for a broad group of problems in mathematical physics that entail solving integral equations whose kernel is a function represented as a Fourier series. Figures 3; references: 4 Russian.

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HORN ANTENNA WITH DIAGONALLY DRIVEN APERTURE

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 (manuscript received 7 Sep 83) pp 45-49

[Article by Ya. D. Glazman, Yu. A. Erukhimovich and I. I. Nepomnyashchiy]

[Abstract] A diagonal horn antenna with substantial misphasing in the aperture and wide-angle radiation patterns was investigated experimentally. The antenna consisted of a slightly misphased horn in the form of a smooth transition from a circular waveguide to a square aperture provided by the intersection of a truncated cone and a pyramid in which the electrical field vector was oriented along one of the diagonals. This section was joined with a second part consisting of a square misphased pyramidal horn. The studies indicated that the antenna exhibits a near-axisymmetrical three-dimensional radiation pattern to a level of approximately -30 dB. The far lobe level in a dual-reflector electrical antenna employing this horn is reduced significantly; the cross-polarization maxima of the field component are reduced, and the overall aperture utilization coefficient is increased significantly. Figures 8; tables 1; references 4: 2 Russian, 2 Western.

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POSSIBILITY OF COMPENSATING SYSTEMATIC IONOSPHERIC ERROR IN RADIO ALTIMETERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
(manuscript received 27 Feb 84) pp 2302-2307

[Article by V. M. Pavlov and Yu. S. Rasshcheplyayev]

[Abstract] Systematic atmospheric errors in measuring distances result from the difference in the real rate of propagation of radio waves versus the speed of light in free space. An algorithm is suggested for compensating the systematic ionospheric error in radio altimeters when the carrier frequency of the signal is slightly higher than the critical frequency of the ionospheric plasma, and it is demonstrated that this algorithm is more efficient than the usual algorithm inasmuch as it requires fewer arithmetic operations for implementing it with practically identical computational accuracy. An expression is derived for the ionospheric error of a radio altimeter. The algorithm employed now for eliminating ionospheric errors is called the multifrequency algorithm and boils down to measuring group lags of signals at various frequencies and then solving a set of linear algebraic equations. The specific frequency dependence of the ionospheric error makes it possible to suggest another algorithm for compensating it which requires fewer arithmetic operations. The practical implementation of the algorithm suggested involves the need to find derivatives of various orders of the group frequency lag. A difference schema can be used for this purpose in the simplest case. It is shown that the computation error caused by the approximate nature of the difference schema with a low value of $\omega_0/\omega_{cr \cdot max}$ is smaller than the systematic error of the usual algorithm used. The influence of noise on computational accuracy is taken into account. The error of the algorithm suggested caused by the influence of noise is not greater than the analogous error of the usual algorithm. For a signal with a duration of 3.2 μs and a frequency deviation of 320 MHz, relative root-mean-square errors in measuring the group lag at an altitude of 450 km equalled $4.1 \cdot 10^{-7}$ for a signal-to-noise ratio of Q = 2, and $2.6 \cdot 10^{-7}$ for Q = 5. Figures 2; tables 1; references: 5 Russian.

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COUPLING BETWEEN ANTENNAS ON A CYLINDER IN PRESENCE OF RIB-TYPE STRUCTURES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
(manuscript received 22 Oct 84) pp 2308-2315

[Article by A. G. Kyurkchan and M. Kh. Zimnov]

[Abstract] The problem is discussed of the coupling and radiation of two slotted-guide antenna arrays placed on the surface of a circular cylinder with a rib-type decoupling structure placed between them. Antennas with a non-flat

aperture make possible a considerably more extensive choice of radiation patterns than antennas with a flat aperture. In an ideally conducting circular cylinder of radius a whose axis is directed along Oz, N_1 sectorial waveguides are cut, ideally matched with the load and of angular width α, having a spacing of β on the circumference, and excited from within. There are also N_2 sectorial flutes of various depths forming a rib-type structure, each of which has an angular width of α_1, and they are an angular distance of β_1 apart from one another. And, finally, there are N_3 passive ideally matched sectorial waveguides. The case of H-polarization is discussed, i.e., when the problem of antenna decoupling is the most complex. The field outside the cylinder is represented by employing Green's theorem. An expression is derived for the field inside sectorial waveguides and slots. The boundary problem is reduced to a Fredholm integral equation of the first kind in terms of the distribution of the electric field in apertures, and it is solved by Feld's orthogonalization procedure, which makes it possible to reduce the solution of this equation to computations utilizing recursion formulas. The excitation coefficients of the receiving array's waveguides, which govern decoupling, and the receiving array's radiation pattern are defined as functionals of the sought function. The results are discussed, of calculation of the coupling constant of an antenna array consisting of nine uniformly excited radiating slots with a receiving slot for the cases when there is a rib-type structure consisting of 20 flutes between the array and slot with parameters $\beta_1 = 0.048$, $\alpha_1 = 0.024$ and $d = 0.3\lambda$, and when there is no such structure, i.e., the array and slot are located on a smooth-surface cylinder. The radius of the cylinder, k_0a, where k_0 is the wave number, equaled 26.18, the angular dimension, α, of the slots was assumed to equal $\pi/39$, and the array's spacing equaled $\beta = \pi/38$. It was demonstrated that the presence of a rib-type structure had but a slight influence on the form of the antenna's radiation pattern, while the coupling constant was reduced by 17.6 dB with the presence of the structure. In this particular case the relatively low coupling constant was due to the influence of the "round-the-world" wave emitted from the nine slots of the array. Figure 6; references: 10 Russian,

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DISTRIBUTIONS OF FAST FADING RATE OF SIGNAL IN TROPOSPHERIC RADIO LINKS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
(manuscript received 26 Jan 84) pp 2298-2301

[Article by O. P. Frolov]

[Abstract] Information on the fast fading rate of a signal in tropospheric radio links is necessary for a number of applications, e.g., in evaluating the rate of response of adaptive antennas. A statistical estimate is made of

distributions of the rates of change of the amplitude and phase of a tropospheric signal. The rates of change are normalized for their median values. The mathematical model describing fast fading of a signal, u, in a tropospheric radio communications link is in the form of the sum of the signals from N repeater stations with random amplitudes, a_n, and phases, f_n. Here with a sufficiently high value of N the differential probability density of the amplitude of the resultant signal, u_0, is described by the Rayleigh law. Probability density functions are determined for the rate of change in the phase of a tropospheric signal, V_f. Then the characteristics of probability density function V_a are determined. Expectation functions $M[V_f]$ and $M[V_a]$ are determined. Integral distributions are presented for normalized ratios V_a/σ_V and V_f/σ_f along with their median values and these are compared with data on normalized distributions of the duration of fast fading for the UHF and SHF bands. The theoretical integral distribution of the rate of change of the amplitude agrees sufficiently well with the experimental data, especially for the SHF band. Figures 2; references: 7 Russian.

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STATISTICAL CHARACTERISTICS OF TIME INTERVALS BETWEEN ATMOSPHERIC NOISE PULSES IN VLF BAND

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85 (manuscript received 17 Mar 83) pp 2316-2321

[Article by L. T. Remizov, A. G. Paskual, V. A. Yepanechnikov and I. V. Oleynikova]

[Abstract] A generalized description, suitable for engineering calculations, of experimental data on the distribution of time intervals between VLF noise pulses is needed for the purpose of analyzing the influence of atmospheric noise on the reception of legitimate signals. Experimental data are presented on the probability distribution of time intervals between atmospheric noise pulses from the results of recording the vertical component of the natural electric field and two magnetic field components on the earth's surface in the frequency range of 3 to 30 kHz in the temperate zone and in the tropics. The wide frequency range was selected in order to take into account the dependence of the time structure of the noise on the receiver's sensitivity and bandwidth and the influence on measurement results of the receiver's resonant frequencies in narrowband reception, explained by redistribution of the energy of lightning discharges in terms of spectrum. The data recording and processing procedure was designed for a statistical analysis of the characteristics of time intervals between noise field pulses. Pulses were recorded by means of a linear wideband receiver and the antenna used was a vertical rod 3 m high for recording the

vertical electric field, and the magnetic field pickups were horizontally or vertically oriented symmetric-type ferrite core induction coils for recording the horiztonal or vertical magnetic noise field. Pulse sequences were recorded on magnetic tape and the random values of time intervals between pulses recorded on the tape were converted into code and entered into an SM-4 computer. Histograms were plotted and calculations were made automatically, of the differential and integral probability distributions of the time intervals, τ, between atmospheric noise. Measurements were made in the USSR from 13 August through 23 August 1980 and in Cuba from 3 August through 8 January 1979. The choice of widely varying recording conditions was due to the desire to reveal noise characteristics independently of the time and place of measurements. The relationship was sought between the statistical characteristics of time intervals between pulses and their flux level, ν. The values of the quantiles of intervals were determined for all experimental histograms for probabilities of 0.9 and 0.5, i.e., $\tau_{0.9}$ and $\tau_{0.5}$, for this purpose. The principal practical result of the study is the revelation of the dependence of $\tau_{0.9}$ on the pulse flux level as the simplest indicator of the noise situation. Quantile $\tau_{0.9}$ is dependent on the total pulse flux level and it is identical for various measuring conditions and various field components and can be used for practical calculations of the time characteristics of noise when evaluating their influence on the reception of legitimate signals with a known noise flux level. A model is employed in which the noise field is represented as a Poisson process of a group of pulses with an intragroup Poisson process diminishing exponentially in terms of level. An expression is derived for the probability density of time intervals between pairs of adjacent pulses for this model. Comparison of experimental data with the refined model showed good agreement. Figures 3; references 9: 6 Russian, 3 Western.

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STATISTICAL CHARACTERISTICS OF DIRECTION- AND RANGE-FINDING NOISE IN POLARIZATION AVERAGING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
(manuscript received 1 Dec 83) pp 2353-2360

[Article by R. V. Ostrovityanov and A. A. Monakov]

[Abstract] The polarization characteristics of signals from luminous points of extended targets exert a considerable influence on direction- and range-finding noise, on which the accuracy of direction and range finding depends. When a signal is scattered by a complex target the polarization is transformed and this transformation is of a random nature when a moving target is being tracked. The influence of this effect on direction- and range-finding noise is especially pronounced with variable polarization of the antenna of the

radar measuring unit. A statistical estimate was made in earlier studies of the averaging influence of regular rotation of the plane of polarization of the antenna, but this was done only approximately for a two-point model of an extended target. Here it is verified whether the results can be extended to a multipoint target. A study is made of the statistical characteristics of direction- and range-finding noise, employing a multipoint model of an extended target. The cases are considered, when depolarization of the signal is of a purely random nature and when all luminous points have identical polarization characteristics. It is shown that there is a quantitative relationship between the effectiveness of polarization averaging and the statistical parameters of polarization of the reflected signal. A relationship exists between the polarization structure of the reflected signal and polarization averaging because the presence in the target of luminous points, i.e., depolarizers, results in transformation of the original polarization of the sounding signal, which, in turn, is a necessary condition for polarization averaging of direction- and range-finding noise. The degree of polarization averaging of this noise can be estimated on the basis of experiments, since the polarization scattering characteristics of a target can be determined relatively easily experimentally. With linear polarization of the sounding signal and the presence in the structure of an extended target of depolarizers, the signal reflected from the target is elliptically polarized. It is confirmed that there is a statistical relationship between the ellipticity factor and the standard deviation of noise in polarization averaging for a target with identical polarization properties of luminous points. It is shown that this is true also when the polarization properties of the luminous points differ. It is concluded that the maximum effect of polarization averaging originating in rotation of the plane of polarization of the radiating antenna is characterized by an approximately threefold reduction in the standard deviation caused by direction- or range-finding noise. The polarization averaging effect is a slowly varying function of the polarization properties of the luminous points; approximately the same averaging result is obtained even when they are only slight depolarizers. The averaging effect can be predicted if the mean value of the ellipticity factor of the reflected signal is known beforehand. Figures 3; references: 2 Russian.

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ASYMPTOTICALLY EQUIVALENT ALGORITHMS FOR PROCESSING RANDOM SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
(manuscript received 26 Jan 84) pp 2387-2390

[Article by A. Z. Kiselev]

[Abstract] The principal processing algorithm for the problem of detecting random signals against a background of interference is a computation of a quadratic functional whose kernel is defined by an equation of the Wiener-Hopf type. The practical implementation of devices for computing a functional of

this type necessitates replacement of the precise kernel by a certain approximate one; and the precise solution can be too complicated for practical use. It is accordingly of interest to construct another functional which will be simpler for hardware implementation and will not distort the properties of the sample function in the discrimination of certain types of random signals. The kernels of the quadratic functional currently used and of the new one suggested are compared. It is demonstrated that with a great number of observations, or an increase in the observation interval, the approximating processing system can deviate without restriction from the precise system while preserving identical properties with regard to the discrimination of any pair of processes defined by their spectral densities. Not only is point proximity of the kernels of these equivalent algorithms not necessary, but proximity in the mean of these functions is also unnecessary. The quality of solutions in the detection problem is evaluated by the probability of correct detection with a fixed probability of false alarms. In constructing the approximating operator it is shown that approximation of a complex operator reduces to the approximation of a simple operator. Accordingly, it is possible to simplify considerably equipment implementing this class of processing algorithms. Figures 1; references 9: 8 Russian, 1 Western.

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EFFECTS OF ARTIFICIAL HIGH-POWER RADIO-FREQUENCY RADIATION ON EARTH'S IONOSPHERE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
pp 2463-2465

[Article by L. A. Lobachevskiy, G. S. Bochkarev and S. G. Lukishova]

[Abstract] The contents are reported, of papers presented at the "Effects on the Earth's Ionosphere of Artificial High-Power Radio-Frequency Radiation" All-Union symposium held in Suzdal at the end of September 1983. The 14 survey reports and 31 communications were divided into four areas: modification of the upper (F-region) ionosphere; modification of the atmosphere and lower ionosphere; effects of low-frequency radiation on the upper ionosphere and magnetosphere of the earth; and the modulation of current streams, and geophysical effects. Principal attention has been paid in recent years to nonlinear phenomena in the F-region of the ionsophere, where the natural frequencies of the plasma are close to the frequencies of the HF band and resonance interaction is taking place between radio waves and plasma. A paper discussed the most important plasma processes in the region of the reflection of powerful radio waves from upper layers of the ionosphere. Other paper topics included the following: Results obtained by means of the Institute of Terrestrial Magnetism, the Ionosphere and Radio Wave Propagation's diagnostic systems; The method of multifrequency Doppler sounding and resulting disturbances of the F-region of the ionosphere; Artificial ionization of the E-layer; The results of studies of the Scientific Research Institute of Radio's diagnostic system of the self-influence of powerful pulsed and continuous radio waves in the E- and F-layers of the ionosphere; Studies of the parametric mechanism of the effect of powerful radio pulses on the ionosphere by measuring the relative attenuation of brief echos of a powerful radio pulse, as well as of the parameters of medium-scale artificial ionospheric inhomogeneities based on an analysis of Doppler amplitude and angle spectra in the disturbed and undisturbed state of the ionosphere; Artificial ionospheric turbulence; Artificial periodic inhomogeneities originating in a stationary or slowly moving interference structure for a high-power radio wave field; A study of features of aspect scattering of radio waves in small-scale inhomogeneities excited by a powerful radio wave; The results of theoretical and experimental studies of an artificially disturbed region of the ionosphere represented as a localized large-scale inhomogeneity and of its influence on the characteristics of shortwave signals in problems of radio wave propagation; The spreading of artificial inhomogeneities in the upper ionosphere; A new mechanism for local heating of small-scale inhomogeneities involving the capture and absorption of shortwave plasma oscillations; Artificial strictional parametric instability; Dynamic characteristics of stimulated radio emission of the ionospheric plasma; The acceleration of electrons in the region of reflection from the ionosphere of powerful radio waves; The artificially ionized region in the ionosphere at an altitude of 30 to 60 km which is able to reflect radio waves over a wide frequency band and can be created by means of intersecting beams of powerful electromagnetic waves; The oblique propagation of radio waves in the ionosphere; A study of nonlinear phenomena in the polar ionosphere and Propagation of the VLF radiation of a transmitter in the high-latitude magnetosphere and ionosphere. Joint studies by Soviet researchers and foreign scientists, as well as studies by foreign scientists alone, were also presented. Of special note is the discovery of a new phenomenon in an experiment on the Interkosmos-19 satellite utilizing the on-board soft-electron spectrometer: Local acceleration of particles of the ionospheric plasma near the satellite by the radio emission pulses of the powerful transmitter of the on-board ionospheric sounding station. The results were confirmed by independent measurements from the ISIS-1 and ISIS-2 satellites. The experimental facilities for studying the effect on the ionosphere of high-power radio-frequency radiation located in the Soviet Union operate in the short- and medium-wave bands in either the continuous or pulse mode. The majority of studies presented at the symposium were performed at the Zimenki and Sura stations in Gorkiy and the Moscow and Monchegorsk stations.

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TV STATION SWITCHBOARD AND CONTROL PANEL ATRS-5/1

Moscow VESTNIK SVYAZI in Russian No 12, Dec 85 pp 23-24

[Article by Yu. V. Novoselov and V. S. Gurkin]

[Abstract] A special panel was constructed for switchboard control of an ATRS broadcasting station from easily available components. It comprises the following equipment: input and communication panel for sound and video signals; unit for control and processing of input signals; panel for control points communication; two video-control units and an oscillograph; two telephones and a PA system for the telecenter personnel; sound level indicator and a clock. As needed, this panel could be expanded to include other options. This control panel should improve operations of the broadcasting station. Figures 3.

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BROADCASTING CABLES WITH HYDROPHOBIC FILLERS

Moscow VESTNIK SVYAZI in Russian No 12, Dec 85 pp 21-22

[Article by Yu. L. Budyanskiy, Yu. I. Kopacheva, V. I. Kolomenskaya, N. N. Zhivotova and N. P. Shaydo]

[Abstract] Specifications for broadcasting cables are given. Either copper or aluminum conducting wires are used and are covered with porous ethylene, filled with hydrophobic filler and encased in either a plastic or metal outer shell. Over and underground laying of this cable is possible, including in areas infested with rodents. Stable electric characteristics are maintained on these cables up to 15 years. Costs and mechanical and electric specifications are given. Construction of these cables saves on polyethylene and copper. Figure 1.

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CONSUMER RADIO EQUIPMENT AT BOUNDARY OF FIVE-YEAR PLAN

Moscow RADIO in Russian No 12, Dec 85 pp 24-25

[Article by G. Pakharkov and V. Prokofyev, Leningrad]

[Abstract] In the 12th Five-Year Plan improvement of consumer sound reproduction equipment was accompanied with a further expansion of the range of products and an improvement of the user qualities. The basic parameters of acoustic systems, amplifiers, turntables, and electric record players manufactured at present and those planned for output are listed, as well as various changes made in equipment and its nomenclature. Further development of sound reproduction equipment will proceed by way of improvement of the quality of its sound because of the use of more progressive circuit engineering and the use of new forms of acoustical-electrical transducers. Tables 3.

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ULTRASHORT WAVE FREQUENCY MODULATED RECEIVERS WITH PHASE AUTOMATIC FREQUENCY CONTROL

Moscow RADIO in Russian No 12, Dec 85 pp 28-30

[Article by A. Zakharov, Krasnodar]

[Abstract] Attention of radio amateurs is called to several simple ultrashort wave (USW) FM receivers with phase automatic frequency control, realizable by means of direct synchronization of the local oscillator frequency with the signal received. The following units are described in some detail and their principal circuits are presented: 1) A radio receiving device used in all the designs; 2) A pocket radio receiver which assures loudspeaker reception; and 3) A simple steorophonic USW FM receiver. The design of a variometer, and the circuit of an USW attachment to the VEF-202 commercial transistorized receiver are also considered. Figures 5; references: 3 Russian.

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SIGNAL LEVEL GAUGES BASED ON K157DA1 INTEGRATED CIRCUIT

Moscow RADIO in Russian No 12, Dec 85 pp 31-33

[Article by D. Lukyanov, Moscow]

[Abstract] Use of the K157DA1 IC in signal level gauges is studied. This IC was one of the first wide-spread IC used in a converter of alternating into direct voltage. It has a wide (more than 40 db) range of linear conversion,

small power consumption, and the possibility of being used in various types of detectors. A detailed description is given of a signal level gauge using this IC. Figures 5; references: 2 Russian.

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INSTRUMENT FOR DEBUGGING DIGITAL DEVICES

Moscow RADIO in Russian No 12, Dec 85 pp 36-38

[Article by V. Vlasenko, Moscow]

[Abstract] An instrument for debugging digital devices, which combines into one unit all the devices ordinarily required for this purpose, is described. The instrument basically consists of a two-channel fixed frequency generator, a remote logic probe, a device for testing its efficiency (test-signal generator), and a power supply unit. In addition to its direct purpose, the instrument can be used as a crystal oscillator or calibrator, as well as the power supply unit of a checking device. Details of the instrument are presented. Figures: 5.

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PULSE POWER SUPPLY UNIT OF YUNOST Ts-404

Moscow RADIO in Russian No 12, Dec 85 pp 40-42

[Article by V. Trofimov and V. Gadzhidiran, Moscow]

[Abstract] An improvement of the power supply unit is one of the means for increasing the economical operation of the ever increasing number of television sets operated in the USSR. However, the classical power supply units with a transistor stabilizer have a low (not more than 50%) efficiency factor as well as a considerable size and mass. The so-called pulse power supply units have considerably better characteristics. Such a unit used in the portable color television receiver Yunost Ts-404 is described. The pulse block unit assures direct voltage of 12, 30, 50 volts, and a pulsating voltage of 6.3 volts with load currents, respectively of 0.7; 0.45; 0.75 and 0.35 amperes. During a change of the 220 volt power-line voltage in the range +6... -10%, the instability of the 12-volt output voltage amounts to 0.5%, for 30 and 50 volts 3%, with the amplitude of pulsations, respectively, 14, 840, and 280 mV. The pulsating voltage fluctuates in these same limits. Figures 3.

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FLAT MATRIX TV SCREEN CONTROLLERS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85 (manuscript received 13 Mar 85)
pp 9-14

[Article by A. A. Rysin]

[Abstract] Different designs are examined for flat-matrix TV screen controllers that employ binary counters as pulse-width converters in the column control units. Three schemes are described: one that incorporates an analog-digital converter that converts the input TV signal to an N-bit binary code, a second without a serial-parallel register unit, and a third in which the horizontal screen buses are separated. It is found that pulse-width modulation using binary counters makes it possible to create comparatively simple controllers for TV matrix screens. The choice of a particular circuit arrangement is determined by the type of matrix screen employed. The comparative ease of the manufacture of devices employing the different approaches is assessed. Figures 6; references: 3 Russian.

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WAVE OF THE PARALLEL MODE IN BALANCED OUTPUT CIRCUITS OF HIGH-POWER SHORTWAVE TRANSMITTERS

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 (manuscript received 22 Jul 85)
pp 38-43

[Article by V. I. Komissarov]

[Abstract] The possible causes of asymmetry of the currents and voltages in the RF output circuits of high-power shortwave broadcast transmitters are investigated. Conditions are identified under which differences of the electrical lengths of the coaxial lines can cause a sharp drop in the level of the wave of the parallel mode in the output circuits and feed circuit of the transmitter. The formulas derived can be used, when the standing wave ratio with respect to the wave of the parallel mode is known, to define requirements for the acceptable difference of the electrical lengths of the lines that ensures the necessary symmetry in driving the output circuits and feed circuit of the transmitter. Excitation symmetry can be improved by adding an active or variable reactive load to the circuit for the wave of the parallel mode. Experimental tests on a mockup feed circuit show good agreement with the theoretical findings. Figures 10; References 4: 3 Russian, 1 Western.

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METHOD FOR PROTECTING SHORTWAVE ANTENNAS FROM SPONTANEOUS DISCHARGES

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 (manuscript received 7 Jan 85)
pp 43-45

[Article by S. V. Voynov and Ts. I. Tsanev]

[Abstract] A system is described that provides protection of shortwave antennas from spontaneous discharges, which are a specific type of high frequency gas discharge occurring in the shortwave band, in antenna feed systems. Spontaneous discharges, which result from a drop in the permittivity of the atmosphere, are now identified by systems in which the protection is activated after the spontaneous discharge occurs at some point in the antenna feed system, often after damage has occurred, which puts the radio out of operation. In the proposed system, information is provided about the dynamics of the atmospheric permittivity, thus preventing spontaneous discharges in the antenna feed system by reducing temporarily the amount of power input to the feed system. The proposed system works by creating an artificial inhomogeneity in the feed system, about which a region with increased electromagnetic field strength is created. When the free electron concentration is increased due to some factor, the permittivity of the atmosphere drops, finally resulting in a spontaneous discharge at the end of the inhomogeneity. The latter is registered by a sensor, and a control unit generates a signal to reduce the transmitter power. The system makes it possible to operate at maximum power and to obtain information on the behavior of the atmospheric permittivity. Figures 3; references: 5 Russian.

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PSEUDORECURSIVE DIGITAL FILTERS

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86 (manuscript received 26 Dec 84) pp 38-40

[Article by L. N. Beskin]

[Abstract] A pseudorecursive digital filter is synthesized, a filter as selective as a recursive one but much shorter. Structurally it is a modified nonrecursive one with frequency multiplexing but with smaller constant filtration coefficients and thus a lower degree of complexity. Its algorithm consists of a nonrecursive convolution followed by a recursive one and its structure consists, correspondingly, of a nonrecursive part and a recursive part in series behind. Just as nonrecursive filters, pseudorecursive filters can be designed as symmetric ones with an essentially linear phase characteristic and as thinned-out multiband filters. The nonattenuating sequence of errors appearing in the recursive part after the first turn-on, for instance, can be suppressed by any analog low-pass filter or by an integrating network. Figures 2; references 1: Russian.

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UDC 621.382.3

METHOD FOR IDENTIFYING PREFERENCE STRATEGY IN SYNTHESIS PROBLEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 1, Jan 86 (manuscript received after revision 28 Dec 84) pp 54-59

[Article by A. I. Solodovnik and I. I. Kizema]

[Abstract] A preference strategy is developed for a synthesis algorithm that employs directed searching in the space of possible realizations. The algorithm makes it possible to construct numerical estimates of the edges of the search directed graph and, in conjunction with algorithms for selecing optimal paths in the graph, makes it possible to extract the optimal schematic diagram from among the set of versions found. The algorithm was implemented in PL-1 and employed with a computer-aided design system, yielding satisfactory results in

terms of speed, as well as the quality of the estimate of the solution of the synthesis problem. The method makes it possible to construct a mathematical model of the structural synthesis of electronic circuits based on accumulated information on the design of a similar class of circuits. The model makes it possible to formalize the experinece of developers, to construct a model of the solution of the concurrent multicriterial problem in L-defined situations, and to construct a multi-step discrete optimization model in the space of possible realizations of the electronic circuits. Tables 2, figures 2, references 9: 7 Russian, 2 Western.

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UDC 621.396.6.002

DESIGN OF ELECTRONIC DEVICES WITH REQUIRED PRECISION OF PARAMETERS

Moscow RADIOTEKHNIKA in Russian No 12, Dec 85
(manuscript received after revision 18 Apr 85) pp 78-80

[Article by A. V. Krivosheykin]

[Abstract] The conventional method of designing electronic devices, namely determining the optimum vector of nominal values of their parameters according to the criterion of performance probability, is simplified by replacement of this centering problem for nominal values with a minimax problem for tolerances. The conditions for performance are linearized in terms of Bode sensitivities with appropriate weight factors. This approach is extended to determination of nominal values and tolerances, with the aid of statistical tests. The procedure is demonstrated on the design of a fifth-order high-pass Cauer filter. Figures 1; references 6: 3 Russian, 3 Western.

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CSO: 1860/195

HOW TO SEARCH FOR FAILURES IN DUMKA APPARATUS

Moscow VESTNIK SVYAZI in Russian No 12, Dec 85 pp 42-43

[Article by B. N. Nikolayev, senior scientific worker Central Scientific Research Institute of Communications, and S. P. Prussak, chief engineer]

[Abstract] DUMKA (Duplex Universal Multiplex Channel Apparatus) serves to create 72 telegraph channels in one voice frequency channel. The quality of these channels depends on the signal converter assuring transmission of a discrete stream at a rate of 9600 or 4800 bits/s. Trouble-shooting procedures are described for a number of possible breakdown situations. Step by step checkout testing procedures are described. Evidently interest in this subject was shown by telegraph workers in Magnitogorsk, Chelyabinsk and Minsk. Figures 4.

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UDC 621.39:519.8

METHODS OF INCREASING EFFICIENCY OF PROGRAMMED MODELS SIMULATING INFORMATION NETWORKS

Moscow ELEKTROSVYAZ in Russian No 1, Jan 86 (manuscript received 10 Jul 84) pp 38-42

[A. A. Monin and V. N. Shakin]

[Abstract] An important problem in design and performance analysis of large information networks by means of computer-programmed statistical models simulating such networks is to ensure a high efficiency of these models, principally on account of computer time and memory capacity constraints. For an effective approach to the problem, the model structure is broken down into its three subsystems implementing the three stages of the simulation process: 1) the transportation subsystem for changing the state of the information set which simulates transmission and processing of messages; 2) the measurement subsystem for acquisition of statistical data and estimating the probability-time characteristics of the object; 3) the control subsystem for converting the current state of the information set into a binary set of conditions which

determine the routing of messages. The efficiency of the entire programmed model depends on how each stage of the simulation process is implemented. For illustration, it is shown how the operation of a telegraph message switching center can be efficiently simulated in the GPSS language, with the aid of a POINTER indicator array. The efficiency of such a model can be calculated and maximized on the basis of programmable applicable design formulas and performance curves. Figures 2; tables 2; references 17: 15 Russian, 2 Western (both in Russian translation).

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DEBUGGING OF PROGRAMS IN DESIGN OF COMMUNICATION EQUIPMENT ON MICROPROCESSOR BASE

Moscow ELEKTROSVYAZ in Russian No 1, Jan 86 (manuscript received 5 Mar 85) pp 43-45

[Article by B. M. Rakhimbekov]

[Abstract] The most laborious and costly stage of software development for microprocessor-base communication equipment is debugging, the last stage after initial design of programs and their subsequent coding. Programs must not only meet stringent speed and accuracy requirements but also be economical, especially for communication systems operating in real time. Programming in lower-level language, assembler language being most often used in such systems, is difficult and the major source of errors so that debugging with the use of large general-purpose computers and their cross-referencing aids becomes most expedient. It is also advisable to ease the debugging process by more carefully designing and coding the programs in the first place so as to reduce their error content. Quite effective in this respect is structural programming, namely up-to-down design followed by partitioning into program modules and structural coding, especially since such a procedure tends to limit the internal complexity of programs. The general rule applicable to software development by any method is that an error can be more easily corrected in the software than in the hardware and that it will always be simpler to modify a program than to modify already built equipment. References 5: 2 Russian, 3 Western (all in Russian translation).

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UDC 621.395.4

REDISTRIBUTION OF CHANNELS IN MULTIPOLE DIGITAL TRANSMISSION SYSTEMS

Moscow ELEKTROSVYAZ in Russian No 1, Jan 86 (manuscript received 9 Aug 84) pp 45-48

[Article by N. I. Artyukhin, R. K. Kvrivishvili and R. N. Mzhavanadze]

[Abstract] Redistribution of channels, simply accomplished in digital telephone networks, can be controlled and even automated in special tandem junctions so that the transmission system becomes a multipole one. While the channels can be redistributed here automatically or manually, a method of automatic redistribution is proposed which effectively utilizes the statistical characteristics describing the busy or clear state of channel bundles in each direction. The mathematical model for calculating the state of a channel bundle is based on the method of random fluxes. The redistribution control algorithm is based on the mean repetition rate and the mathematical expectation of coincidence pulses indicating equal numbers of busy channels in each direction as the input information. The pulse flux is best characterized by two parameters, namely the mathematical expectations of pulse repetition rate and channel busy time, one of these parameters sufficing for evaluation of the service quality when the distribution of single busy times is known. The efficiency of this method and the resulting increase of throughput capacity are demonstrated on the example of one channel added to a bundle in a small local telephone network. Figures 5; references: 6 Russian.

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DISCUSSION OF PROBLEMS IN CORROSION PROTECTION OF UNDERGROUND COMMUNICATION EQUIPMENT

Moscow ELEKTROSVYAZ in Russian No 1, Jan 86 p 51

[Unsigned article]

[Abstract] Progress made in corrosion protection of underground communication equipment was discussed by the Science and Engineering Council at the USSR Ministry of Communication during a conference held in June 1985. Already over 20,000 km of symmetric and coaxial cables have been inspected by enterprises operating nationwide or in individual republics. The principal causes of corrosion were found to be a highly aggressive soil (35%), latent defects in the sheathing (25%), and absence of electrochemical protectors (25%). The corrosive action of copper salts contained in insulating crepe paper and soluble in water was studied, among others, whereupon countermeasures have been developed. Most of the still unresolved problems are in the area of technical management, particularly shortage of efficient field service and of specialists. Recommendations made by the Council are to develop methods of estimating the corrosion hazards and of protecting lead-armored cables as

well as cables in service over 30 years, to centralize by 1986-87 accountability and responsibility in matters pertaining to problems of corrosion protection of all underground metallic equipment, and to emphasize preventive measures prior to installation under competent technical supervision.

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CRITERIA FOR DESIGNING NONRECURSIVE FILTERS WITH CHARGE-COUPLED DEVICES

Moscow ELEKTROSVYAZ in Russian No 1, Jan 86 (manuscript received 2 Aug 84)
pp 59-60

[Hans Eigler (GDR)]

[Abstract] The design of monolithic integrated-circuit nonrecursive filters using charge-coupled devices is analyzed from the standpoint of two critical parameters which combine all criteria into an equivalent one and reduce the latter to tolerances. These parameters are nonuniformity of the amplitude-frequency characteristic over the passband, and noise. The first one depends very much on the filter technology and the second one depends very much on the filter structure. Both upper and lower limits for the number of filter sections to meet performance as well as reliability and cost requirements are set, after discrepancies between calculated and measured amplitude-frequency characteristics have been reconciled on the basis of a statistical analysis of manufacturing imprecision with the standard deviation reference. The design of a discrete 2-stage low-pass filter on the basis of its analog equivalent has been corrected accordingly on the basis of an experimental prototype built with the apparatus of n-MOS technology and in conformity with CCITT G.712 recommendations. Figures 2; references 6: 2 Russian, 4 Western (1 in Russian translation).

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THEORETICAL PRINCIPLES UNDERLYING STANDARDIZATION OF COMPONENTS FOR RADIO ENGINEERING SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86 (manuscript received 3 Apr 85)
pp 17-19

[Article by G. V. Aleshin and V. Ye.Pustovarov

[Abstract] Standardization of components for radio engineering systems is analyzed, considering that maximization of its advantages requires not only expertise based on "trial and error" but also solution of the global problem.

As a simple illustrative example serves a radio engineering system with a single information channel, for measuring a parameter of target motion or for transmission of data. The corresponding global problem of standardization covering all such systems is formulated so as to involve all the principal aspects of the standardization process: discretization of sizes and values, serialization of components, and minimization of deviations from optimum design values. The aim is to minimize the manufacturing cost and to contain the total system cost. Analysis and calculations are simplified by assuming a uniform distribution of standards of any system component over the entire range of any one parameter, and by expanding the cost target function into a Taylor series in the vicinity of a stationary point in the parameter space of the entire class of systems. Taking into account the cost dynamics in the production time domain or in the product series domain, the standards optimization problem is solved by the method of dynamic programming with factorization of the product quality indicators. The solution is a single-step exact one for linear cost contraint functions, to be used for iterations in the case of convex nonlinear cost constraint functions. The result is obtained in a form which indicates how the production of components ought to proceed. Figures 1; references: 2 Russian.

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ANALYTICAL MODEL DESCRIBING SUSCEPTIBILITY OF RADIO RECEIVER TO INTERMODULATION INTERFERENCE

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 2 Sep 85) pp 28-31

[Article by L. Sh. Alter]

[Abstract] A mathematical model is constructed which describes the susceptibility of an FM radio receiver to third-order interference. It is based on the fact that two or three strong interference signals with frequencies such that $2f_1 + f_2 = f_0 \pm b$ or $\pm f_1 \pm f_2 \pm f_3 = f_0 \pm b$ (f_0- operating frequency of main receiver channel, $2b$- bandwidth of intermediate-frequency channel) can produce intermodulation interference which lowers the signal-to-noise ratio at the receiver output. The equations of this model are derived for a receiver in which the useful signal passes through an amplitude limiter. The interference signal at the mixer output is assumed to consist of the receiver noise and the nonlinear product of interference signals coming from the receiver input. Both gain and noise of the radio-frequency channel are assumed not to depend on the amplitudes of the interference signals. According to this model, the susceptibility to interference depends linearly on the input signal voltage when the latter is much higher than the limiter setting and does not depend on it when it is much lower than the limiter setting. In the case of only slightly attenuated intermodulation interference the susceptibility of the receiver to it does not depend on its frequency. In the case of strongly attenuated intermodulation interference the susceptibility of the receiver to it is determined by the circuit parameters of the input stage. This model can serve as basis for computer-aided evaluation of electromagnetic compatibility. References: 9 Russian.

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READINGS OF QUADRATURE COMPONENTS IN DIGITAL RADIO RECEIVERS

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 18 Sep 85) pp 59-63

[Article by M. V. Zarubinskiy and Ye. S. Poberezhskiy]

[Abstract] Oscillations to be discretized in a digital radio receiver are usually narrow-band signals and their quadrature representation simplifies the synthesis of filters with symmetric frequency characteristics as well as the fast Fourier transformation and other operations on the signal spectrum. The quadrature components are usually read in the analog part, by any of the three conventional methods: 1) two-channel synchronous detection and discretization of both sine and cosine components; 2) discretization of the original signal and Hilbert transformation with the aid of a phase shifter; 3) reading pairs of instantaneous signal values separated by a time interval $\Delta t = 1/4f_0$ at a frequency $f_d = f_0/m$ (f_0 - center frequency of signal, $m = 1,2,\ldots$). All three methods involve transfer of the signal spectrum onto the null frequency in the analog part, which contributes to distortions owing to null drift and nonlinearities as well as noise. This drawback can be eliminated by reading the complex oscillation in the analog part but transferring it onto the null frequency in the digital part. The difficulty of synthesizing quadrature channels with identical and stable characteristics can, however, be overcome only by also reading the complex oscillation in the digital part. Since only one channel is then needed in the analog part, the quadrature representation will not be destabilized and the number of adjustment operations will be reduced. On this premise is considered use of the digital Hilbert transformation and the equivalent digital method of reading pairs of instantaneous signal values. Interpolation of both components is preferably effected by means of the digital main selection filter without an additional interpolating filter. Figures 2; references 6: 5 Russian, 1 Western (in Russian translation).

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DEVICES BASED ON SUPERCONDUCTING RADIO-FREQUENCY CABLES FOR CHECKING ELECTRONIC EQUIPMENT

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 4 Sep 85) pp 80-82

[Article by V. S. Mironov]

[Abstract] An experimental study of superconducting radio-frequency cables and their operation in the pulse mode was made, the purpose being to determine their usability for checking short-range (10^2-10^4 m) and medium-range (10^3-10^5 m) electronic equipment. The study included RK-50-1.5-24SP and RK-50-1.5-25SP as well as "model 2" cables. In the basic test circuit a cable segment in parallel with an instrument attenuator were connected between two microwave switches, with a microwave oscillator--rectifier--modulator line before the first switch and a microwave rectifier--amplifier--detector line behind the second switch, a frequency meter between oscillator and first rectifier, a power supply feeding into the PIN-diode modulator, an oscillograph at the detector output, and a 12-17 delay generator feeding into the oscillograph directly and into the PIN-diode modulator through a pulse generator. Attenuation and time delay of 0.5 µs microwave pulses in a 279 m long "model 2" cable segment were measured at carrier frequencies of 200-700 MHz (systematic and random errors within ±2 ns and ±3 ns respectively, no pulseform distortion). Attenuation and time delay of 30 ns and 300 ns microwave pulses in an 80 m long RK-50-1.5-24SP cable segment were measured at carrier frequencies of 8.678-9.467 GHz (systematic and random errors ±0.5 dB, ±2 ns and ±0.2 dB, ±0.1 ns respectively, pulse form distortion with "tail" and serrated top attributable to inhomogeneities in cable). Attenuation in the RK-50-1.5-24SP cable segment was found to be 1.5-4 times stronger than in an ideal homogeneous cable segment according to published data. At frequencies above 1-2 GHz the attenuation depends not only on the carrier frequency but also on the signal spectrum. The possibility of multiple reflections in a recirculator, a 40 m long RK-50-1.5-25SP cable segment between two terminal reflectors (short copper strip line with gap in one conductor), was established by regulating the gap width so as to ensure minimum energy loss in the reflectors. The author thanks D. Ya. Galperovich for supplying cable specimens and for helpful discussion, also Ye. I. Sychev for valuable comments. Figures 4; references 6: 4 Russian, 2 Western.

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OPTIMAL PROCESSING OF RECURSIVE SIGNALS IN MULTIPATH CHANNEL

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 29, No 1, Jan 86 (manuscript received 7 Jun 85) pp 3-7

[Article by A. K. Morozov]

[Abstract] An optimal algorithm is synthesized for processing complex signals based on recursive codes in a stochastic multipath channel. The algorithm extends the idea of the Viterbi decoder to a broad class of channels with memory; the principle of optimal combination of oscillations arriving over distant paths is extended to the case of recursive signals. The extension of Viterbi's algorithm to the case of multipath channels makes it possible to implement signal detection by sequence estimation. The duration of the recursive signals can be made smaller than their multipath stretching time in the channel, thus increasing the data rate. References: 4 Russian.

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ROBUST DETECTOR FOR SUBCARRIER INTENSITY MODULATED OPTICAL RADIATION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 29, No 1, Jan 86 (manuscript received 8 Feb 85) pp 31-36

[Article by K. Ye. Rumyantsev]

[Abstract] A robust algorithm is derived for detecting optical radiation that is intensity-modulated by a subcarrier with quantum noise limitations on the photodetector. The approach is based on using a filter to extract the subcarrier oscillations and measuring the envelope of the process. The proposed detector guarantees a specified false alarm probability and requires no adjustment of the threshold function while in operation. The optimal robust detector takes information from three or four of the expansion elements preceding the element being analyzed. The case of N=4 is found to be best for implementing the detector in digital form. Figures 2, tables 2, references: 8 Russian.

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PIPELINE FAST FOURIER TRANSFORM SCHEMES WITH ARBITRARY OVERLAP OF INPUT DATA ARRAYS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 29, No 1, Jan 86 (manuscript received after revision 30 May 85) pp 37-43

[Article by L. M. Osinskiy and O. V. Glushko]

[Abstract] A unified methodology is proposed for analyzing and synthesizing pipeline fast Fourier transform (FFT) schemes. The proposed solution is based on the development and investigation of a pyramidal structure for a pipeline FFT scheme that generates the set of all organization versions of pipeline processing of overlapping data arrays. An FFT algorithm is proposed that makes it possible to derive a structure in which all of the processors are processing only essential sample pairs in each cycle, with no repeated processing of those pairs. The structure of a pipeline FFT circuit for N=1024 and L=896 is presented as an example. The configuration makes it possible to synthesize Fourier processors that satisfy the requirements imposed for real time digital signal processing. Figures 2, references: 2 Western.

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DISCRETE PERFORMANCE AND COST OPTIMIZATION OF RADIO LINES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 12, Dec 85 (manuscript received 19 Feb 85) pp 35-41

[Article by S. V. Ratafyev]

[Abstract] Optimization of radio communication lines implies meeting the performance requirements at the minimum cost. The performance indicators are fidelity and speed of transmission along with channel capacity. The cost is measured not only in terms of expenses for equipment and operation but also in terms of consumed energy and assigned frequency spectrum. The problem is solved by first selecting the best kind of signal modulation and signal code, then optimizing the energy characteristics of the line, namely transmitter power, receiver sensitivity, receiver noise, and antenna gain with respect to cost. The radio line is represented schematically as a sequence of functional components between message sender and listener. They are the transmitter stage comprised of a message-to-signal converter, a modulator, a power amplifier, and an antenna, the medium through which electromagnetic waves propagate from transmitter antenna to receiver antenna, this component of the line having invariant properties and being cost-free but also a source of interference, and the receiver stage comprised of an antenna, a linear segment, a demodulator, and a signal-to-message converter. Each component is treated as a four-pole network with known power transmission coefficient, intrinsic output noise,

and annual operating cost. The problem is solved by the method of dynamic programming, in accordance with the principle of multistep optimization. The complex overall problem can thus be split into simpler problems of local optimization for each component on each step. Dynamic stipulation of requirements is facilitated by defining them not in terms of numerical values but in terms of ranges of equivalence, of equivalence with respect to the requirements themselves and equivalence with respect to the tolerances on them, whereupon those ranges are expediently subdivided into equivalence intervals. The main difficulties in solving this optimization problem arise from the lack of known cost relations, the multiconnectedness of regions in which their arguments are defined, and the intricate nonlinearity of applicable constraints. The simpler an element of the system is, the more easily can the cost relation for it be established. Subdividing the system components into many elements, on the other hand, brings about a burdensome excessive multidimensionality. Only multilevel analysis of a radio communication line can lead to a workable solution of the optimization problem by the given procedure with any degree of accuracy. Figures 2; references 6: 4 Russian, 2 Western (both in Russian translation).

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STATISTICAL ESTIMATION OF IMMUNITY OF RADIO SIGNALS TO INTERFERENCE WITH DISCRETE SPECTRUM

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 12, Dec 85 (manuscript received after revision 23 Jan 85) pp 41-45

[Article by Yu. Yu. Vosilyus and A. A. Sikarev]

[Abstract] Immunity of discrete radio signals to interference with a discrete spectrum is evaluated with the aid of parametric maximum-likelihood estimates pertaining to the cross-discrimination coefficient relative to a lumped reference interference. The statistical characteristics of these estimates are determined on the basis of an analysis of independent readings, specifically for narrow-band signals. Such readings of the cross-discrimination coefficient are obtained with an instrument consisting of a reference-interference generator and a phase shifter in series, two multipliers for the incoming radio signal on the generator side and on the phase shifter side respectively, two integrators, two squaring devices, and an adder with two inputs to the squaring devices, one to each, and with one output through an interference-matched filter and then a strobing device to a normalizing device. Figures 2; references: 4 Russian.

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CODING NOISE AND DESIGN FEATURES OF DIGITAL SIGMA-DELTA MODULATOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 12, Dec 85 (manuscript received after revision 5 Apr 85) pp 10-15

[Article by Yu. S. Vlasyuk]

[Abstract] A digital sigma-delta modulator with one digital integrator is considered, this integrator being preceded by a digital subtractor and followed by a 2-level quantizer or sign fixer. Its performance with a sequence of pulse-code-modulated multidigit readings $\{x_n\}$ as input signal is compared with that of a Van de Weg analog sigma-delta modulator. The coding noise power is estimated, assuming the input signal to be a random process. In the design of such a modulator it is expedient to place before it a digital interpolator so as to increase the discretization frequency without an increase of the coding noise power. With the input signal appropriately scaled so that $0 \le x_n \le 2^B - 1$, the modulator structure can be simplified by use of a B-digit storing summator as integrator. The signal-to-noise ratio at low signal levels can be increased by adding a constant bias at the modulator input. This will not decrease the signal-to-noise ratio at high signal levels, because the energy spectrum of the error tends to become uniform, but it will narrow the dynamic range of the input signal. The magnitude of this bias must, therefore, be selected on the basis of a tradeoff. Using such a modulator rather than an array of precision resistors and capacitors for a digital-to-analog converter will facilitate large-scale integration. Figures 4; references: 5 Western (2 in Russian translation).

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DEPENDENCE OF FIDELITY OF REGENERATED DIGITAL SIGNAL ON PRECISE TIME BASE SYNCHRONIZATION

Moscow ELEKTROSVYAZ in Russian No 1, Jan 86 (manuscript received 17 Dec 84) pp 28-31

[Article by I. Ye. Baydan, B. V. Karpukhin, Yu. A. Pavlichenko and O. O. Spozito]

[Abstract] Regeneration of a digital signal is considered and a method of precise time base synchronization to ensure high fidelity is proposed, namely automatic phase control of the local oscillator relative to time base intervals. This will eliminate phase jitter in a filter-discriminator with an insufficiently narrow passband. The regenerator in this scheme contains an amplifier-corrector of distorted input signals, a coincidence circuit acting as resolver,

and a synchronizer with two analog switches. At the inputs of these switches appear also reference signals of meander waveform by which the input signal is multiplied, coming from the control oscillator through a trigger-shaper stage. The control loop includes also a memory with two analog cells, a subtractor, and an accumulator. The interference immunity of signal regeneration according to such a scheme depends on the precision of phase control setting as well as on the frequency stability of the control oscillator. Figures 9; references 4: 3 Russian, 1 Polish (in Russian translation).

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EVALUATION OF COMPUTER METHODS OF CALCULATING ERROR PROBABILITY IN REGENERATORS OF DIGITAL SIGNALS

Moscow ELEKTROSVYAZ in Russian No 1, Jan 86 (manuscript received 12 Nov 84)
pp 25-27

[Article by V. E. Gurevich and A. Ye. Nazimok]

[Abstract] Two computer methods of calculating the error probability in regenerators of digital signals in transmission channels with pulse code modulation, the iterative numerical-analytical method and the simulation method, are compared with respect to speed and accuracy. The first method requires approximating the probability density function of intersymbol interference, the second method requires a huge sample volume. In the second method, however, no extra memory capacity for storing the distribution function of intersymbol interference is required and the accuracy of the error probability estimate is determined directly during estimation. The number of time base intervals depends here on the pulse form of the resolver input signal, but the estimation error does not increase with increasing number of those intervals. The simulation method which includes constructing an algorithm for formation of the appropriate code sequence and selecting the appropriate number of significant time base intervals, is therefore preferable for this particular application. Tables 2; references 11: 8 Russian, 3 Western.

2415/5915
CSO: 1860/204

UDC 681.3.05:681.7.014.3

ALGORITHMS OF DIGITAL IMAGE PROCESSING

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86 pp 58-59

[Annotation of Article No 695 by A. A. Aleksandrov and S. G. Glotov, deposited at Informsvyaz Center of Scientific and Technical Information]

[Abstract] The device (UK Patent No 2,100,956) which transforms the coordinates of a raster element for digital image processing in accordance with the algorithm $\begin{bmatrix}X\\Y\end{bmatrix} = \begin{bmatrix}a & b\\c & d\end{bmatrix} \times \begin{bmatrix}x\\y\end{bmatrix} + \begin{bmatrix}f\\g\end{bmatrix}$ is quite universal, being applicable to a broad spectrum of transformations, but its speed is limited by the operation of multiplication. For digital image processing in real time is proposed a device (USSR Patent disclosure No 3,750,994/24 dated 4 Dec 1984) which transforms the coordinates of the (i + 1)th element according to the algorithm $X_{i+1} = X_i \pm a$, $Y_{i+1} = Y_i \pm c$. Coding errors such as those caused by empty elements in the transform are in this device corrected by removal of "holes". The procedure is based on the method of inverse transformation and involves successive sorting of transform elements (X,Y) essentially by zeroth-order interpolation on the original. References 3: 2 Russian, 1 Western.

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UDC 621.396

OPTIMUM LENGTH OF STATIONARITY INTERVAL FOR ESTIMATION OF SIGNAL-TO-NOISE RATIO ON BASIS OF MAXIMUM LIKELIHOOD

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 12, Dec 85 (manuscript received after revision 4 Feb 85) pp 51-52

[Article by V. V. Shirokov]

[Abstract] The optimum length of a stationarity interval in a nonstationary channel with varying signal-to-noise ratio is determined, which will ensure the minimum error of a signal-to-noise ratio estimate on the basis of maximum likelihood. This optimum length represents a tradeoff, it must be sufficiently long to allow a large number of readings but also sufficiently short to exclude large changes of the signal-to-noise ratio which will influence the accuracy of such an estimate. On a stationarity interval such an estimate is formed by assuming that the number of distortions has a binomial distribution. Finding the optimum length of this interval requires solving the equation $d\varepsilon^2/dm = 0$, where ε^2 is the estimate error normalized to the dispersion of the estimation process h(t) and m is the total number of signals on a stationarity interval. The optimum interval corresponds to the number of signals m with which the error ε^2 is minimum. After discretization and quantization of the continuous estimation process h(t), this error will decrease as the correlation function R(τ) of the process h(t) averaged over a discretization interval increases. The estimate h of the signal-to-noise ratio is obtained by solution of the problem $\hat{h} \to \max_h P(\hat{p}|h) = C_m^{m_u} p^{m_u}(h)[1- p(h)]^{m- m_u}$, where m_u is the number of distorted signals, $\hat{p} = m_u/m$ is the estimated probability of signal distortion, p(h) is the true probability of signal distortion, and $P(\hat{p}|h)$ is the likelihood function. Figures 1; references 6: 4 Russian, 1 Western (in Russian translation).

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OPTIMIZATION OF INFORMATION TRANSMISSION SYSTEM WITH RESPECT TO SET OF TECHNICAL AND ECONOMIC INDICATORS BY COMPOSITION METHOD

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 12, Dec 85 (manuscript received after revision 28 Jan 86) pp 71-74

[Article by N. S. Gubonin]

[Abstract] The method of composition is used for optimizing information transmission systems according to the absolute preference criterion. Application of this criterion on the whole is demonstrated on a system consisting of two independent simplex subsystems and its optimization by this method with respect to a set of four technical and economic performance indicators in standard form: 1. transmission speed, 2. mean time between failures, 3. probability of error in reception of one symbol, 4. transmission range. Each subsystem consists of an encoder, a transmitter with antenna, a receiver input stage with antenna, and a decoder. When one subsystem is to serve as standby for the other, it is necessary to consider that they may operate in different frequency bands or that they may have been differently structured. It is then most expedient to consider two possible situations, a loaded standby ensuring transmission with the same speed and reliability or an unloaded standby corresponding to a system with a faulty channel. Typical other variants of such a system consisting of two subsystems are a duplex one or one with a digital return channel, one with relaying to a satellite, and a segment of a radio relay line. They all satisfy the first theorem of composition so that, when the optimization problem can also be solved directly without composition, the solution to the equation of the working surface is a function which coincides with the multidimensional exchange diagram with a Pareto set in the space of variates for all values of its argument and is also the solution to the minimization problem of the composition method. For such systems it is possible to construct a fast algorithm of numerical solution and, under certain conditions, obtain an approximate analytical solution. Figures 1; tables 2; references 4: 3 Russian, 1 Western.

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UDC 621.396.62:621.372.632

FREQUENCY CONVERSION WITHOUT PARASITIC COMBINATION FREQUENCIES

Moscow RADIOTEKHNIKA in Russian No 12, Dec 85
(manuscript received after revision 11 May 85) pp 38-45

[Article by Yu. I. Sharapov]

[Abstract] A method of frequency conversion by mixers in radio receivers is proposed which produces an intermediate-frequency band $f_i = f_h - f_s$ (heterodyne frequency f_h higher than signal frequency f_s) without harmonic and combination frequencies $\pm nf_s \pm mf_h$. Variable signal frequency $f_{sj} = f_s \pm \Delta_s$ and variable heterodyne frequency $f_{hj} = F_h \pm \Delta_h$ cause the cutoff points on the $(f_j/f_h, f_s/f_h)$-nomogram ($0 \le f_j/f_h \le 1$, $0 \le f_s/f_h = f_L/f_U \le 1$, f_L- lower cutoff frequency, f_U- upper cutoff frequency) shift into a forbidden band. Each combination frequency has a forbidden band of a different width, a wider band corresponding to a higher order of combination frequency. The gist of the method is making the width of the allowed band between forbidden bands within the $(f_s/f_h)_{min}$ and $(f_s/f_h)_{max}$ ranges equal to $f_{ij} = f_i \pm \Delta_i$ and then finding $(f_s/f_h)_{opt}$ within that allowed band. For practical implementation of this principle, the constraints on harmonic and combination frequencies at the $(f_s/f_h)_{min}$ points are defined so as to apply to all conversion bands and to all mixers. On this basis, the necessary frequency relations have been derived for a simple Class C mixer, a balanced mixer ($2f_s = 4f_s = 0$), and a doubly balanced mixer ($2f_s = 4f_s = 2f_h = 4f_h = 0$). These relations indicate in each case the maximum heterodyne tuning range feasible for a given intermediate-frequency band with use of ideal band-pass filters and the proper choice of mean single heterodyne frequency. Figures 2; tables 4; references 3: all Russian.

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UDC 621.371

USING STATISTICAL MODEL OF RADIO WAVES PROPAGATION IN DESIGN OF RADIO NETWORKS FOR 30-1000 MHz FREQUENCY RANGE

Moscow RADIOTEKHNIKA in Russian No 12, Dec 85 (manuscript received 1 Dec 84) pp 74-77

[Article by V. V. Zakharov]

[Abstract] A procedure for territorial design of radio and television broadcasting networks as well as radio communication networks operating in 30-1000 MHz frequency channels is developed on the basis of a statistical model of

radio waves propagation. The electromagnetic field intensity at any distance from the base station, transmitter station in broadcasting networks, is represented as a process randomly varying in time. Fading is caused by inconstancy of the vertical dielectric permittivity gradient in the atmosphere. Variation of the time-average field intensity along any circle around the base station is caused by nonuniform shading of the surface relief, with a log-normal distribution. The differential field intensity distribution and the median field intensity exceeded at half of all points on a circle at least half of the time are calculated on the basis of such a model, namely the CCIR model with several refinements contributed by Soviet authors (A. A. Shur, Yu. M. Kalinin, B. F. Melnikov). Next is determined the radius of the service zone, namely the radius of the circle at any point of which the probability of a signal exceeding the minimum perceptible level at the receiver input is equal to the recommended one (90% probability for broadcasting and communication with stationary objects). The territorial spacing of transmitters is then determined on the basis of signal and interference levels, to ensure adequate interference immunity depending on the type of network (color or black-and-white television, mono or stereo sound broadcasting, general-purpose mobile ground communication, industrial communication). The procedure is somewhat longer for spacing of base stations which are to operate in a joint frequency channel. Figures 5; tables 1; references 10: 3 Russian, 7 Western (4 CCIR).

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FREQUENCY-TIME SELECTION OF MULTIPLICATIVE NOISE IN MOBILE RADIO SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85
(manuscript received after revision 30 May 85) pp 38-42

[Article by E. S. Golovin]

[Abstract] The effectiveness of frequency-time selection as a means for combatting multiplicative interference caused by multipath radio propagation in spread-spectrum mobile radio communications systems is assessed. It is found that when the signal base exceeds unity, the matched filter in the receiver of the mobile platform performs time selection of multiplicative interference. The effectiveness of selection increases as the base of the spread spectrum signal; the gain over narrowband systems is more significant in multipath signals with severe time scattering. It is only possible to realize the effectiveness of combined frequency-time selection by making the spectrum of the radio signal significantly wider. However, the code multiplexing capability provided by spread spectrum systems facilitates multiple access to the same wideband channel, and thus does not result in underutilization of the spectrum as compared with traditional narrowband systems employing frequency division multiplexing, while providing a significant gain in communications reliability under difficult noise conditions. Figures 3; references 3: 2 Russian, 1 Western.

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UDC 621.396.626

CALCULATION OF ERROR PROBABILITY IN DETECTING SIGNAL ELEMENT IN CHANNEL SUBJECT TO SPOT JAMMING

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85
(manuscript received after revision 20 May 85) pp 55-57

[Article by L. A. Obcharenko and Ye. V. Chuchin]

[Abstract] An expression is derived for the probability of erroneous reception of a signal element in a channel without fading on the basis of the error probability of a signal with Rayleigh fading against the background of non-fading interference. The inverse Laplace transform of an equivalent expression is then taken to find the probability of erroneous reception with an additive mixture of spot jamming and random white noise input to the decision circuit in the absence of fading. A program which implements the error calculation algorithm that runs on a B3-44 calculator is presented. Tables 2; references: 5 Russian.

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THEOREMS REGARDING SHIFTS DURING DECIMATIONS OF M-SEQUENCES

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85 (manuscript received 5 Dec 84) pp 58-61

[Article by A. A. Bessarabova]

[Abstract] The decimation property of M-sequences (the conversion of one sequence to another (or to another cyclic shift) by selecting its kq-th elements is called decimation with respect to the subscript q) is investigated. Three theorems are formulated and proved: 1) the inversion of the k-th shift of an M-sequence yields the (m-1-k)-th shift of the sequence, which is the inverse of the initial sequence; 2) the decimation with respect to the subscript q of two signals that are separated by 1 elements yields a difference of 1/q between the shifts Δkl of the resultant M-sequence; 3) the number of the shift k_{1q}^{p} obtained by decimation of the 1-th shift of the p-th M-sequence with respect to the subscript q

$$k_{lq}^{p}=k_{x}^{r}-k_{x}^{p}/q+l/q,$$

where k_{x}^{p} and k_{x}^{r} are the numbers of the characteristic shifts of the initial, the p-th, and the resulting r-th sequences. Sequences shifted by 1/q elements can thus be found by decimation of successive shifts of any M-sequence with respect to the subscript q. Tables 2; references 6: 5 Russian, 1 Western.

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DISCARDING OF ANOMALOUS ERRORS DURING RECEPTION OF SAMPLES IN TELEMETERING SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85
(manuscript received after revision 1 Mar 85) pp 65-69

[Article by L. G. Zhuravin, E. I. Semenov, and V. A. Troshkin]

[Abstract] Statistically optimal algorithms are proposed for discarding signal samples corrupted by anomalous errors in telemetering systems employing wideband modulation. The algorithms make it possible to reduce the probability of occurrence of anomalous errors by several orders of magnitude, and also to reduce the threshold signal/noise ratio somewhat, thus exhibiting approximately the same characteristics as methods for filtering anomalous errors in each channel. The proposed algorithm is not affected by error bursts, because its working characteristics are independent of whether the preceding samples were received correctly. The root-mean-square gain achieved by discarding corrupted samples is analyzed as an example, indicating a 4 dB drop in the detection threshold. Figures 2; references: 6 Russian.

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FAST TUNING OF MATRIX CORRECTOR IN FREQUENCY DOMAIN

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85 (manuscript received 5 May 85) pp 91-94

[Article by V. B. Zotkin and D. L. Korobkov]

[Abstract] A method is examined for speeding the convergence of an adaptive matrix corrector in the frequency domain in order to reduce intersymbol interference in digital channels. The matrix correction algorithm consists of taking the discrete Fourier transform of the channel output signal vector, performing the correction in the frequency domain, and taking the inverse discrete Fourier transform. Computer simulation shows that the proposed method provides a gain of approximately 10logR dB over that described in a previous study by the authors, due to a corresponding three-fold reduction in the observation variance. Figures 1; references: 4 Russian.

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SUPREME SOVIET INITIATES COMMUNICATIONS MINISTRY CORRECTIVE MEASURES

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 pp 1-3

[Article from PRAVDA, 1 Sep 85]

[Abstract] In spite of the achievements of the USSR Ministry of Communications in expanding and improving communications services for the population, a review by the Presidium of the USSR Supreme Soviet, made at the request of the Committee on Transportation and Communications of the Council of the Union and the Council of Nationalities, reveals failure to exploit all of the reserves and possibilities for expanding the network of communications enterprises and improving service to the public. Deficiencies ranging from uneven distribution of communications enterprises across the union republics to slow installation of residential telephones and late mail delivery are cited. Conversion and reequipping of communications enterprises is moving too slowly. Successful enterprises and organizations are not sharing and disseminating their experience sufficiently. Increases have been noted in the number of complaints associated with newspaper, telegram, and money order delivery and long repair time for telephones and wired radio outlets. The latter are especially prevalent in the Azerbaydzhan, Moldavian, and Uzbek SSR, as well as a number of krays and oblasts in the RSFSR and the Ukrainian SSR. Instructions and recommendations from the Presidium to the Ministry of Communications to overcome these problems are outlined. The Ministry of Communications and other state entities are to report their results to the Presidium of the Supreme Soviet of the USSR by 1 September 1986.

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CSO: 1860/178

RURAL TELEPHONE COMMUNICATIONS

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 p 9

[Abstract] This article is an editorial introduction to a series of nine articles on rural telephone communications. The articles examine general aspects of the construction and improvement of rural telephone networks, the hardware employed, methods for organizing communications between exchanges, suggestions on automated management of rural telephone network expansion, rural communications cables, and satisfying existing norms. The effectiveness of centralized network control is emphasized. The implementation of digital transmission systems in rural networks is described. The type of facilities required for low-density applications is discussed.

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INTRODUCTION OF COMMON-CHANNEL SIGNALLING SYSTEM IN RURAL TELEPHONE NETWORKS

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 (manuscript received 1 Mar 84)
pp 14-17

[Article by N. A. Sokolov and P. A. Yunakov]

[Abstract] The interaction of stored-program automatic telephone exchanges in rural telephone networks is outlined. Alternative common-channel signalling arrangements are described. The interaction among different signalling systems is explained. The reliability of signalling networks is analyzed. It is recommended that stored-program exchanges be introduced in rural networks starting at the central exchange, which makes it easiest to employ common channel signalling. As stored-program exchanges are added to the network, the signalling network must be built in such a way as to improve signalling reliability and reduce costs. There must be no more than one transition from the common channel signalling system to a decentralized system within a rural network. Inexpensive signal transmission devices are recommended for voice grade channels or physical circuits because the high throughput capacity of common channel signalling systems and the small groups of trunks employed in rural networks allow slow transmission rates for signalling information. References 6: 5 Russian, 1 Western.

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UDC 621.315:621.395

STATUS AND PROSPECTS FOR DEVELOPMENT OF RURAL COMMUNICATIONS CABLES

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 (manuscript received 2 October 84)
pp 20-23

[Article by N. A. Avdalyan, M. A. Boss, and Yu. A. Parfenov]

[Abstract] The technical specifications of communications cables employed for interexchange trunks in rural networks are presented. The electrical characteristics of types KSBP, KSPZP, and BKSPZP cables are presented in tabular form. The use of types TPP and PRPPM cables in subscriber cable networks in rural areas is described. Types of cable planned for use in the future for trunk-lines and for subscriber loops are described. The electrical characteristics of high-reliability type TPP cables are presented in tabular form. Tables 2; references: 3 Russian.

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UDC 621.396.56

ZONA-15 EQUIPMENT COMPLEX FOR RURAL PRIMARY NETWORKS

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 (manuscript received 25 Apr 84) pp 24-29

[Article by A. P. Bayev and V. M. Perlin]

[Abstract] This study presents the function, makeup, and basic specifications of the Zona-15 equipment complex, which is used for constructing and expanding rural primary networks employing type KSPP single-quad cable. The Zona-15 provides voice-grade channels in 30- and 50-channel groups, channels to carry supervisory signals for automatic rural exchanges, class-II audio broadcast channels, 8-kbps data channels, channels with capacities of up to 100 and 200 bps, and extraction and redistribution of these channels, as well as baseband circuits, at nodes in the rural network. Integration of the Zona-15 in rural networks is described. The operation of the digital tandem equipment is explained, and the construction and maintenance of the complex are discussed. Figures 6; tables 4; references: 6 Russian.

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UDC 621.394.621(088.8)

PROSPECTS FOR DEVELOPMENT OF DIGITAL TRANSMISSION SYSTEMS FOR OVERHEAD SUBSCRIBER LINES

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 (manuscript received 25 April 84) pp 33-38

[Article by B. N. Maglitskiy, O. N. Porokhov, and I. V. Sitnyakovskiy]

[Abstract] The distinguishing features of overhead subscriber loops and the requirements for the signals they carry are analyzed. The basic requirements for digital transmission systems employed on such lines are outlined. Ways for improving the utilization of the throughput capacity of digital transmission systems are explained. The 3B2T-OMC three-level monopulse signal transmission method is decribed. By switching rural networks to cable lines employing digital transmission on overhead subscriber loops, it is possible to expand the networks and increase the number of channel-kilometers without removing existing line structures. Figures 4; tables 4; references 14: 13 Russian, 1 Western.

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UDC 621.395.743

RURAL TELEPHONE NETWORK HANDLING OF INCOMING CALLS FROM MANUAL LONG DISTANCE EXCHANGE AT RAYON CENTER

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 (manuscript received 9 Apr 84) pp 42-46

[Article by L. M. Golshteyn]

[Abstract] Alternative ways are discussed for meeting existing attenuation standards for the portion of the signal path from the subscriber's telephone set to the long distance exchange. Because the trunks employed in rural networks are very long, attenuation considerations make it necessary to use transmission channels for trunks, and to employ four-wire tandem connections in the equipment at central and node exchanges. It is difficult to meet attenuation standards between the subscriber's set and a manual long distance exchange at the rayon center because of the technical impossibility of setting up four-wire tandem connections at the exchange either for traffic handled through a long distance switchboard, or for imcoming automatic and semiautomatic traffic. It is found that attenuation standards can be satisfied by using crossbar and quasielectronic equipment in rural networks and retaining four-wire tandem connections of transmission channels at central and node exchanges. The use of physical three-wire long distance trunks is recommended for connections with subscribers of central exchanges and those terminal exchanges that are connected to central exchanges by physical two-wire trunks; four-wire physical long distance trunks are recommended for connections with subscribers of node exchanges and with terminal exchanges that are connected to a central exchange via transmission channels. Figures 7; references: 3 Russian.

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UDC 621.396.43

ESTIMATION OF OPERATING STABILITY OF DIGITAL RADIO RELAY LINKS SUBJECT TO FREQUENCY-SELECTIVE FADING

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 (manuscript received 16 May 85) pp 47-50

[Article by N. I. Kalashikov and P. G. Kaplunov]

[Abstract] A general method is developed for estimating the operating stability of digital radio relay links subject to fading caused by reflections from stratified tropospheric irregularities. In contrast to previous methods, the proposed method allows for the possibility of increasing frequency of errors due to a drop in the level of the received signal as well as due to distortions caused by the selective properties of fading. The analytical results agree satisfactorily with experimental findings. The operating stability of a digital radio relay link employing 16 QAM is analyzed as an example,

indicating that selective fading caused by reflection from stratified tropospheric irregularities can be disregarded for data rates slower than 8.448 Mbps. Stability is worse on paths near the ocean than paths over dry land. Increasing the equipment power improves operating stability at data rates lower than 34.368 Mbps; however, the equipment becomes more sensitive to fading selectivity. Increasing the equipment power on high speed digital radio relay links may provide only a slight increase in operating stability. The proposed method can also be employed for fading caused by reflection from the ground. Tables 2; figures 1; references 10: 5 Russian, 5 Western.

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CCITT RECOMMENDATIONS ON GENERAL MAINTENANCE PRINCIPLES

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 pp 62-64

[Article by A. A. Rozhdestvenskiy]

[Abstract] A review is presented of three new CCITT recommendations on technical maintenance: M.20 "Philosophy of Maintenance of Analog, Digital, and Mixed Networks"; M.22 "Principles of Utilization of Emergency Signalling for Maintenance of International Transmission Systems and Equipment"; M.24 "Principles of Utilization of Maintenance Information for Observing Parameters of International Transmission Systems and Equipment". These recommendations provide a common approach and general instructions for technical maintenance that are helpful for the development of an automated technical maintenance system, as well as instructions and rules for maintenance. Many of the principles set forth in the recommendations are in common use in the telecommunications network, and lie at the foundation of such technical documentation as the maintenance rules. References 3: 1 Russian, 2 Western.

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UDC 621.391.28

TRENDS IN DEVELOPMENT OF SWITCHING METHODS

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 (manuscript received 12 Dec 84) pp 6-10

[Article by V. A. Bogatyrev and I. A. Mizin]

[Abstract] A review of switching methods, starting with channel switching and message switching and ending with packet switching, is made. The trends in the development of switching methods are analyzed from the viewpoint of switching

facility complexity, the volume of the portion of information that is switched, switching delay, the responsibility for the switched portion of information, and channel utilization efficiency. An extrapolation is made on the basis of current trends in the development of switching methods. The extrapolation indicates that the main distinguishing feature of one possible alternate implementation of the switching method of the future is a reduction in the switched portion of all information transmitted, which is explained by an attempt to simplify switching nodes, as well as requirements that switching delays be reduced to values that support near real time transmission of any information, including speech. Future integrated-service networks are likely to employ a combination of packet or channel switching that will satisfy equally the requirements for transmission of all types of information. Figures 4; references 3: 1 Russian, 2 Western.

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UDC 621.395.345

COMMON BUS METHOD IN SETTING UP DISTRIBUTED CONTROL AT SWITCHING NODE

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 (manuscript received 28 Jan 84) pp 10-14

[Article by E. B. Ershova, A. V. Kazarnovskiy and L. N. Torshina]

[Abstract] The possibility is investigated of constructing distributed microprocessor control systems that employ a standard method for setting up interprocessor interaction over a common bus made up of a common address bus, a common data bus, and control buses. The use of a common bus in the direct memory access mode is restricted from the viewpoint of addressing by the address space of the type of processor selected, the number of processors in the control system, and the maximum amount of memory required to hold the programs and data of the individual microprocessors. It is found possible to set up interprocessor interaction over a common bus in the direct memory access mode in small-capacity switching systems handling up to 128x2 channels by using eight-bit processors (K580) for the distributed control devices, while 16-bit processors (K1810) can be employed for up to 8000x2 channels. The use of common bus interaction between processors in the synchronous transfer mode is restricted from the viewpoint of addressing by the number of processors in the system, the amount of data transferred between processors, and the word length of the type of processor employed. Synchronous transfer is considered the basic mode for eight-bit processors, while direct-memory access is considered basic for 16-bit processors. Figures 7; references: 6 Russian.

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DIGITAL FIBER OPTIC TRANSMISSION SYSTEM FOR INTERNAL ZONE NETWORKS

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 (manuscript received 20 Jun 85) pp 18-24

[Article by M. A. Plotkin and Yu. A. Zingerenko]

[Abstract] A digital fiber optic transmission system for internal zone networks that handles 120 or 480 voice grade channels is described. The equipment is used for setting up secondary and tertiary digital circuits over multimode optical cables between exchanges in municipal telephone networks. The line signal employs 5B6B code, with a pulse repetition frequency of 10.138 Mbps in a secondary system, and 41.242 Mbps in a tertiary system. The sensitivity of the photodetection device is analyzed. The organization of auxiliary subsystems and the composition of the complex are described. The equipment employed at terminal and attended intermediate points is explained. The complex makes it possible to set up optical lines carrying from 240 to 1920 channels in internal zone networks. Far fewer attended and unattended repeaters are required than for multichannel transmission systems using cables with metal conductors, which makes line construction and operation less expensive. The equipment is intended primarily for intra-oblast links in areas with comparatively dense population and fail-safe power supply. The design principles and circuitry can be used to a substantial extent to develop mainline optical cable transmission systems. Figures 7; references 10: 4 Russian, 6 Western.

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UDC 621.373.826.621.396

MINIMIZATION OF PULSE DISTORTIONS IN SINGLE-MODE LIGHT GUIDE

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 (manuscript received 12 Apr 85) pp 29-31

[Article by G. I. Gordon, P. A. Mishnayevskiy and I. I. Teumin]

[Abstract] A rigorous solution is proposed for the problem of describing pulse distortions occurring in a single-mode light guide. An expression is derived that describes the form of the signal at the output of the light guide that depends upon the half-width of the pulse at the e^{-1} level; there exist certain values of that parameter for which the signal distortion will be minimal. Special cases of the expression are considered as examples of minimization. The results are of practical interest, and make it possible to estimate actual signal distortions most fully. Figures 1; references 5: 1 Russian, 4 Western.

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METHODS FOR PROTECTING OPTICAL COMMUNICATIONS CABLES AGAINST RODENTS

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 (manuscript received 12 Nov 84) pp 31-32

[Article by V. Ye. Vasilyev and V. A. Kozhurov]

[Abstract] The advantages of the basic methods for protecting optical cables against rodent damage--mechanical and chemical--are weighed. Mechanical protection--placing a polymer-sheathed cable inside sealed steel tubing--is most reliable, but is susceptible to a moisture condensation inside the tubing which damages the cable when the water freezes. Other versions of mechanical protection are described, including making the protective jacket of the cable of separate triangular sections, each of which turns freely with respect to its neighbors when disturbed from outside, preventing rodents from damaging the thin metal sheath. The use of dielectric materials to protect cable is described. The use of chemical means, including poisons and repellents, is described. The use of repellents makes it possible to retain important cable properties, including insensitivity to electromagnetic radiation, lightning protection, etc, with no significant complication of the fabrication technology. References: 13 Western.

6900/5915
CSO: 1860/185

INTERNATIONAL EXHIBITION OF FIBER OPTIC COMMUNICATIONS CABLE IN GENEVA

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 pp 33-37

[Article by V. V. Zakharov, S. D. Manayenkov, P. V. Melnikov and K. K. Nikolskiy]

[Abstract] This article reviews the products exhibited at the international exhibition held by the International Telecommunications Union in Geneva, Switzerland during May 1985. Fiber optic cables produced by ATT, Pirelli, STC, NTT, TCL, SAT, ACOME, SILEC, NT, NKF, Radiall, Raychem, GTE, TRW, Eupen, Plumett, Morel, and Lancier are described. The products range from twisted optical cables carrying copper pairs and quads in addition to optical fibers, and optical cables designed for direct burial in the ground, to line couplers and devices for aligning and joining cables. It is concluded from the scope and variety of the exhibits that the development of optical communications cables is receiving serious attention around the world. Figures 9; tables 1.

6900/5915
CSO: 1860/185

WAYS OF REDUCING MAINLINE CONSTRUCTION COSTS

Moscow ELEKTROSVYAZ in Russian No 12, Dec 85 p 49

[Unsigned article]

[Abstract] This article outlines the action items flowing from a discussion of reports presented by the State Institute for Communication Facilities Research and Design and the All-Union State Trust for Interurban Wire Communication Facilities at a meeting of the Scientific-Engineering Council of the USSR Ministry of Communications held in February 1985. The Council adopted a number of directions for implementing the integrated program for improving communications line construction, ranging from increasing the level of industrialization and mechanization of construction to increasing the proportion of conversion and reequipping of existing facilities and replacing transmission systems on existing lines with more economical systems. A list of specific Council recommendations for reducing construction cost is presented.

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UDC 621.396.2.019.4

NONLINEAR METHODS OF PROCESSING WEAK RADIO SIGNALS AGAINST BACKGROUND OF STATIONARY NON-GAUSSIAN NOISE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85 (manuscript received 5 Jul 82) pp 2346-2352

[Article by A. Ye. Ulanov]

[Abstract] Optimal algorithms for the detection of weak signals against a background of non-Gaussian noise are synthesized on the basis of the method of modeling the expansion into a Taylor series of the logarithm of the likelihood ratio (LOP). When the kind of noise distribution is unknown a priori, disregarding higher-order terms in the expansion of the LOP is permissible only on the condition that the Taylor series converges rapidly at least in probability under certain conditions, and only the criterion of asymptotic optimality guarantees this convergence. But asymptotically optimal (AO) algorithms can differ from algorithms which are optimal according to the Neumann-Pearson criterion in finite sampling. A detailed analysis has shown that the condition of a good rate of convergence to the optimal is insufficient for the existence of proximity between an AO and optimal algorithm when using an AO algorithm in the limiting case. In actuality, proximity exists for a narrower class of non-Gaussian densities. This question is studied, along with the finding of simple quasi-optimal nonlinear converters which are stable in the face of variation in the energy and statistical characteristics of noise. A single-channel detector is discussed, consisting of a nonlinear bandpass converter in the form of a series-connected nonlinear inertialess element and a bandpass filter with a square amplitude-frequency response, a correlator,

and a resolver, when the sum of a deterministic signal and stationary non-Gaussian noise enters its input. It is assumed that the signal and noise are narrowband processes with overlapping spectra. An analysis is made of the stability and effectiveness of nonlinear algorithms in the asymptotic and limiting cases. Nonlinear algorithms are effective only in systems in which there is a sufficiently large amount of information on the signal; these include information transmission systems utilizing signals with a complex structure whose bandwidth-duration product, B, is much greater than one. The results prove that under conditions of a priori nonparametric uncertainty, a multichannel detector of complex radio signals having nonlinear converters of the kind discussed is simple to implement and operates stably with a change in the probability characteristics of noise. The algorithm presented can be implemented by means of a two-channel circuit with a subtractor, one channel of which is linear and the other of which contains an element for cubing the instantaneous voltage. The effectiveness of quasi-optimal nonlinear processing implemented by this receiver is illustrated in an example. With a required signal-to-noise ratio in the correlator's output of +10 dB and a signal-to-noise ratio in the receiver's input of -40 dB, linear processing would require a noncorrelated sample with a size of not less than 10^5 for reliable reception. If the noise is non-Gaussian, the use of nonlinear processing with optimized coefficients makes it possible to achieve the required signal-to-noise ratio with a sample of much smaller size, equal to 10; the gain from its use equals 10^4. Figures 4, tables 1; references: 14 Russian.

8831/5915
CSO: 1860/187

EFFECTIVE PLANS AND SPECIFICATIONS UNDERLIE SUCCESSFUL IMPLEMENTATION OF SCIENTIFIC AND ENGINEERING ACHIEVEMENTS IN COMMUNICATIONS BRANCH

Moscow ELEKTROSVYAZ in Russian No 11, Nov 85 pp 4-8

[Article by G. Monina]

[Abstract] The quality of plans and specifications drawn up by design institutes and planning and design bureaus and departments is evaluated in the light of the recommendations of 1983 and 1985 designer conferences. Although estimated construction costs have dropped, and savings of metal, cement, and lumber have been achieved, plans and specifications are still being drawn up that do not meet recommended requirements. Recommendations are outlined for improving the quality of new designs and specifications, and for the implementation of computer-aided design and improved personnel training. A leading issue is that of improving capital investment structure by increasing the proportion of conversion, reequipping, and expansion of existing enterprises.

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UDC 621.3.049.75.002.3"313"

PROMISING MATERIALS FOR PRINTED CIRCUIT BOARD FABRICATION

Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 85 (manuscript received 30 Jan 85) pp 21-23

[Article by Candidate of Engineering Sciences S. G. Trubachev and Candidates of Chemical Sciences A. V. Vasilyev, V. I. Zaytsev, and L. N. Borisova, All-Union Scientific Research and Design Institute for Insulation Materials and Foil Dielectrics]

[Abstract] This study reviews the characteristics of various printed circuit board materials in use or under development around the world. The characteristics of foil-clad fiberglass boards for subtractive circuit preparation, of fiberglass boards for semiadditive and additive circuit fabrication, and of flexible foil-clad dielectrics based on polymer films are presented in tabular form. A trend is noted toward high conductor density, reduced etching, and high yields of good articles. It is found that the new types of dielectrics that are being developed meet standards for base materials for printed circuit boards. Figures 2; tables 6.

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UDC [621.315.621.6:621.315.619].049.75.001.1

NEW DIRECTIONS IN DEVELOPMENT OF FIBERGLASS LAMINATES FOR ADDITIVE PRINTED CIRCUIT FABRICATION

Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 85 (manuscript received 30 Jan 85) pp 23-25

[Article by Candidates of Chemical Sciences L. N. Borisova and V. I. Zaytsev]

[Abstract] This study addresses the properties of glass cloth-based laminates with chemical metallization catalyzer added, and laminates for photoselective metallization. A base material incorporating aluminum foil with a specified surface roughness for additive printed circuit fabrication developed by the All-Union Scientific Research and Design Institute for Insulation Materials and Foil Dielectrics is described. All three groups of base materials are found to be promising in terms of satisfying user requirements. Figures 2; tables 3; references: 5 Russian.

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UDC 621.385.833.049.77

AUTOMATION OF VISUAL INSPECTION OF MICROELECTRONIC PRODUCTS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
(manuscript received 10 Oct 83) pp 2456-2458

[Article by V. A. Antonyuk, Yu. P. Pytyev and E. N. Rau]

[Abstract] A description is given of a test system based on a combination of a scanning electron microscope and a special-purpose computer which makes it possible to automate visual control of the quality of integrated circuits and other semiconductor structures. The system makes it possible to detect flaws and regions of failure by comparison with a reference, both for active and passive parameters. The computer implements morphological algorithms for solving problems of isolation and identification in real time by utilizing images represented by scanning signals. The experimental unit consists of a scanning electron microscope and a special-purpose computer linked with it, including a video signal processor, an on-line memory, and a synchronizing and scanning unit for controlling scanning of the microscope's electron beam. The computer's algorithms construct the form of the reference image, i.e., its division into regions of uniform brightness, and convert the image under study into an intermediate image having the form of the reference image while at the same time being closest in the root-mean-square sense to the image under study. The image studied is transformed into an intermediate image by construction of the best, in the root-mean-square sense, step-function approximation of the image studied, with fixed division of the field of view into nonintersecting regions. The signal processing unit performs a dual role. A determination is made in it of brightness values and of the configuration of division regions to form the approximation sought in constructing the form of the reference image from the signal. In the process, the arbitrary numbers of the division regions are entered point by point into the memory. When the unit processes the signal of the image under study, concomitantly with scanning of the image the contents of the memory are scanned and the brightness values of the intermediate image are present in the signal processor. The difference between the studied and intermediate images is displayed on the scanning electron microscope's screen and is in the form of an image of regions of lack of correspondence between the item studied and the reference, i.e., an image of defects. The system can be used for internal flaw detection and visual inspection. An example is given of testing a circuit board with integrated transistors. One transistor was used as the reference, and on the basis of an image of it the form of the reference image was constructed and was stored in the memory. The tested transistor was compared with the reference and as a result of processing regions of a lack of correspondence were revealed, i.e., metalization defects and foreign inclusions. The system also makes possible automatic visual inspection of integrated circuits in the working state, including under dynamic conditions. An integrated flip-flop, periodically switched from 1 to 0, was studied. The distribution of potentials in it varied periodically in the process. Signals corresponding to images of the flip-flop in the 0 and 1 states proved to be mismatched in terms of time. One image was used as the reference, and the other was studied for differences by comparison. The image processing speed is dictated by the vertical scanning rate, approximately 10 seconds, but faster scanning, e.g., television scanning, can increase the speed of image processing. Figures 3; references: 4 Russian.

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COMPUTERS

UDC 681.327.6+681.7.068

POSITIONING OF MAGNETIC HEADS RELATIVE TO OPTICAL SCREEN

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86 pp 44-45

[Annotation of article No 673 by A. V. Yermolovich and V. V. Petrov deposited at Informsvyaz Center of Scientific and Technical Information]

[Abstract] A new transducer for positioning magnetic heads relative to magnetic storage disks is described, each information carrying surface of the disk stack being equipped with an annular optical reflecting screen and each magnetic head being equipped with a differential fiber-optic readout device. The optical screen on a disk is an amplitudinal grating of circular strips with alternately high and low reflection coefficient. The optical readout device on a magnetic head consists of fibers with directional couplers between the light source and a photoreceiver. All screens and readout devices can be coated with a 1-3 μm thick ferromagnetic varnish on γ-Fe_2O_3 base, because these materials are highly transparent to light within the same 0.8-0.9 μm wave band of fiber-optic communication lines. The position of magnetic heads in horizontal and vertical magnetic recording devices can be monitored accurately within 0.5 μm, such a high accuracy being required for 5 μm wide magnetic heads. The main sources of transducer error are independently drifting sensitivity of the photoreceivers and independently drifting input characteristics of the photocurrent amplifiers. The error can be reduced by stabilization of the photoreceivers or by automatic correction of their sensitivity difference. Figures 2.

2415/5915
CSO: 1860/201

UDC 621.391.193

CORRELATION-EXTREMAL PATTERN RECOGNITION ALGORITHM

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 1, Jan 86 (manuscript received after revision 18 Dec 84) pp 68-72

[Article by V. K. Baklitskiy]

[Abstract] An approximate solution is derived for the problem of constructing pattern recognition systems for nonlinear space-time signals. A recognition

algorithm is developed for an observed pattern whose position on the observation plane is unknown. Extremal correlation processing of the space-time signals is used to determine whether the observed signal contains a signal identical to the standard signal. Figures 3, references: 4 Russian.

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CSO: 1860/202

ELECTRON DEVICES

UDC 535.087.73

PIEZOOPTICAL INSTRUMENTS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 12, Dec 85 pp 17-19

[Article by I. I. Slezinger, A. N. Aliyevskaya and Yu. V. Mironov]

[Abstract] Piezooptical converters (PC) are based on conversion of the deformation of an expansible element into an optical and subsequently into an electrical signal. The Scientific-Research Institute of Mechanics of Moscow State University developed and tested several modifications of accelerometers, manometers, and dynamometers based on the use of such piezooptical converters. Formulas are given for determining the sensitivity of instruments, the actions of which are based on the piezooptical effect. The results of tests of piezooptical accelerometers are cited. Figures 2; references 3: 1 Russian, 2 Western.

6415/5915
CSO: 1860/177

UDC 621.382

SURFACE MIGRATION INSTABILITY OF MIS STRUCTURES IN MEDIA WITH DIFFERENT MOISTURE CONTENT

Moscow MIKROELEKTRONIKA in Russian Vol 14, No 6, Nov-Dec 85
(manuscript received 13 Nov 84) pp 556-561

[Article by S. N. Kozlov and M. L. Slavova, Moscow State University imeni M. V. Lomonosov]

[Abstract] A method is developed and tested for determining the parameters that characterize the surface migration instability of metal-insulator-semiconductor (MIS) structures based on investigating "broadening" of the inversion channel of a field-effect transistor following the application of voltage to its gate. The kinetics of potential propagation along the dielectric layer surface of an MIS structure are analyzed. The inversion channel current of MIS transistors is determined. Experimental n-channel MIS transistors based on KDB-20 silicon are described and tested in order to determine the surface migration instability parameters of MIS structures. The method makes it easy to study weak migration instability (small moisture contents). Figures 5; tables 1; references 4: 3 Russian, 1 Western.

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CSO: 1860/184

INDUSTRIAL ELECTRONICS AND CONTROL INSTRUMENTATION

UDC 62-50

FREQUENCY SYNTHESIS METHOD FOR OPTIMAL REGULATORS FOR LINEAR SYSTEMS WITH SCALAR PERTURBATION (PART 2)

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 12, Dec 85 (manuscript received after revision 29 Dec 84) pp 33-39

[Article by Ye. I. Veremey]

[Abstract] The synthesis of optimal regulators for linear systems with scalar perturbation is investigated. The second part of the study identifies the conditions for the attainability of the global minimum of the mean square criterion on a subset of the set of arbitrary fractional rational rows of the transfer matrix W(s). The structural features of the optimal solution are investigated. A numerical example is presented. References: 2 Russian.

6900/5915
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UDC 621.694.001.284:389.14

CALCULATION OF REGIMES AND PRECISION CHARACTERISTICS OF FLUID-JET ELEMENTS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 12, Dec 85 pp 6-7

[Article by A. L. Volkov, A. L. Serko and S. V. Firsov]

[Abstract] In certain cases fluid-jet devices are used together with the widely-employed electronic automatic means of gauging linear magnitudes. The ST55 series-produced native industry fluid-jet discrete elements of the Volga system have the widest distribution. However, the design of discrete transducers based on the ST55 gives rise to certain difficulties caused by the absence of a design method suitable for engineering calculations. The complexity of the aerodynamic processes which take place in the element during switching does not make it possible theoretically to analyze the interconnection between its operating parameters and precision characteristics. Consequently, experimental studies were made, the results making it possible to obtain analytical expressions which permit a calculation of the regimes and precision characteristics of ST55 fluid-jet discrete elements at the stage of designing automatic means of gauging linear magnitudes. Figures 2; references: 2 Russian.

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UDC 658.012.011.56.001.4

EFFECTIVE METHOD FOR DEVELOPING DATA BASES FOR AUTOMATED CONTROL SYSTEMS IN MULTI-NOMENCLATURE ELECTRICAL MACHINE BUILDING

Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 85 (manuscript received 8 Apr 85) pp 2-5

[Article by Candidate of Economic Sciences I. Ya. Boguslavskiy, Engineers D. S. Kolosov and Ye. I. Malnykhi, and Candidate of Economic Sciences E. L. Rakhlin]

[Abstract] A combined computer-based manual-machine method for preparing design documentation is described that makes it possible to develop data bases for automated production control systems handling large numbers of different article designs. The method exploits the technical characteristics of the articles (parameters) as means to identify motors as objects of production and consumption, instead of the numerical notations employed in existing traditional methods for preparing design documentation. The use of parametric identification provides the necessary flexibility and information compression when forming group designations. The method was tested successfully at the Kharkov Electrotechnical Plant, and is being implemented at enterprises in the sub-branch. The method has been shown to be very effective, with annual savings at one enterprise comprising between 40,000 and 60,000 rubles: It reduces the amount of labor required to prepare design documentation, compresses the information in developing data bases, reduces the volume of technological documentation, and employs computers for integrated preparation and delivery of design and technological documentation and management system documentation. Figures 3; tables 2.

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UDC 621.9.06-52:621.73.016.3

USE OF INDUSTRIAL ROBOTS TO SET UP AUTOMATED STAMPING LINES BASED ON EXISTING EQUIPMENT

Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 85 pp 13-17

[Article by V. G. Galenko, Yu. Ye. Onichkin, and V. V. Proshlyakov, All-Union Design Institute for Electrical Engineering Production Technology (VPTIelektro)]

[Abstract] Automated stamping lines developed by VPTIelektro as "man-machine" systems are described. The possibility is investigated of using robotized secondary stamping cells employing industrial robots as the basis for robotized stamping lines, which in turn can serve as the basis of more complicated automated structures--flexible production systems. Figures 6.

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UDC 621.3.078:621.313.333

ELECTRIC MOTORS FOR ELECTRICAL ACTUATING MECHANISMS

Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 85 (manuscript received 18 Dec 84) pp 35-36

[Article by Doctor of Engineering Sciences A. S. Kurakin, and Engineers V. N. Pogodin and O. A. Gushchina]

[Abstract] The specifications and requirements for electrical actuating mechanisms and the electric motors they employ are discussed. The use of fixed speed actuating mechanisms in automatic regulation and control systems is described. The DAU series of special-purpose asynchronous electric motors is described. Synchronous motors employing electromagnetic speed reduction are cited as the most promising type of motor at present. Figures 2; tables 1.

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UDC 621.8

ESTIMATION OF FLICKER RATE IN LIGHTING NETWORKS SERVINC MACHINE BUILDING ENTERPRISES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 12, Dec 85 (manuscript received after revision 5 Jun 84) pp 109-112

[Article by O. I. Kotelnikov, R. I. Masulis, G. Ya. Bazin, and I. G. Krakhmalin]

[Abstract] A portable flicker meter designed at the Gorkiy Polytechnical Institute for measuring flicker rates in lighting systems is described. The instrument implements models of two light sources--incandescent lamps and luminescent lamps. The block diagram of the meter is presented and explained. The expressions defining the transfer function and amplitude-frequency characteristic of the filter section of the device are presented. Light flicker readings obtained at the Gorkiy Automobile Plant for a two-year period are presented in a table. Figures 2, tables 1, references: 5 Russian.

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CSO: 1860/176

UDC 621.314.63:621.317

TWO-COMPONENT PHASE-SENSITIVE RECTIFIER

Moscow IZMERITELNAYA TEKHNIKA in Russian No 12, Dec 85 pp 41-42

[Article by I. M. Fedorov]

[Abstract] The two-channel phase-sensitive rectifier (PSR) ordinarily used for simultaneous measurement of certain cophased and quadratic components contains two multipliers controlled by an orthogonal system of reference signals. In the infralow-frequency band each of the multipliers is realized in the form of a precision electromechanical switch. The present article describes a two-component PSR constructed on the basis of one switch multiplier. This device is simpler than known modifications of the PSR and has better operating characteristics. The results of rectification by one of its components (simulated or real) is presented in the form of sinusoidal voltage, which also makes it possible to employ similar phase-sensitive rectifiers in follow-up systems of automatic control operating on alternating current. Figures 1.

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UDC 621.314.63:631.317

SYSTEM OF IN-PROCESS GAUGING OF THE DEPTH OF PRESSING IN SMALL DIMENSION CYLINDRICAL COMPONENTS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 12, Dec 85 pp 9-10

[Article by F. Sh. Abubekirov]

[Abstract] The level of productivity for overall assembly of mechanisms for precision devices depends on the interchangeability of components and subassemblies obtained in preliminary operations. As an example, for the wheel systems of clock-work mechanisms the most essential subassemblies are the mounting plates and bridges with pressed clock-work jewels. As error in the depth of pressing (in the range of 0.01 mm) has an effect on the accurate engagement of the toothed wheels, the retention of lubrication of the jewel bearings, and the immunity to vibration. A theoretical and experimental study is conducted with respect to increasing precision of the depth of pressing of small cylindrical components. An experimental device with in-process gauging of the depth of pressing is described. A test of the device with workable mounting plates of the clock-work and with clock-work jewel bearings was conducted. Error of the depth of pressing was found to be of the order of 0.01 mm. Figures 2; references: 4 Russian.

6415/5915
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UDC 389.14:681.7:519.2

EVALUATION OF THE RELATIVE MAGNITUDES OF THE RADIATION DENSITY OF A PERFECT RADIATOR IN THE SPECTRAL RANGES OF OPERATION OF THERMAL IMAGING DEVICES

Moscow IZMERITELNAYA TEKHNIKA in Russian No 12, Dec 85 pp 27-28

[Article by V. I. Matveyev]

[Abstract] Graphs are developed for simplifying determination of the relative magnitudes of the radiation density of a perfect radiator in the 3.5-5 and 8-14 micron spectral range. These correspond to the special tabulated functions Z ordinarily used in solving the problem. The graphs substantially simplify the necessary calculations with an assurance sufficient for practical precision. Figures 3; references: 3 Russian.

6415/5915
CSO: 1860/177

MAGNETICS

UDC 621.396.621.52

SUPERCONDUCTING QUANTUM MAGNETOMETER WITH PARAMETRICALLY REGENERATED CIRCUIT

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 9 Aug 85) pp 31-34

[Article by A. V. Gusev]

[Abstract] The sensitivity of a radio-frequency SQUID magnetometer is determined, considering the presence of not only thermal noise in the Josephson junction which closes the superconducting ring (ideal sensitivity) but also thermal noise in the regenerative circuit and nonthermal noise in the preamplifier (real sensitivity). Parametric regeneration in the circuit with a variable capacitance $C = C_0/(1- m \cdot \sin \omega_r t)$ is considered, a potential source of additional noise. Calculations are based on the standard circuit equations for a SQUID and a phenomenological model of jumps of the internal magnetic flux, according to the algorithm of optimum filtration. The sensitivity is calculated first for a SQUID with the operating point conventionally on the flat segment of the instrument characteristic and then for a SQUID in the more easily realizable hysteresis mode with the operating point beyond that flat segment. The author thanks V. B. Braginskiy, V. V. Migulin, and V. N. Rudenko for helpful discussion. Figures 2; references: 8 Russian.

2415/5915
CSO: 1860/201

UDC 621.377.623.22

THIN-FILM MAGNETORESISTIVE CONVERTER PLAYBACK SIGNAL

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85
(manuscript received after revision 28 Apr 85) pp 33-35

[Article by S. Kh. Karpenkov]

[Abstract] Simple analytical expressions are derived for the playback signal voltage of magnetoresistive elements consisting of a thin rectangular permalloy film oriented perpendicular to the plane of the magnetic medium. Two approximations are proposed for the magnetic field scattered by an isolated magnetization transition: One described by a quadratic function for longitudinal recording, and one described by an arctangent function for perpendicular. It is

found in both cases that the thickness of the magnetoresistive element must be comparable with the length of the transition. The analytical expressions derived can be used easily to estimate working characteristics, which is very important in developing thin-film magnetoresistive converters for longitudinal and perpendicular recording. Figures 3; references 6: 3 Russian, 3 Western.

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CSO: 1860/183

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REMAGNETIZATION OF ION-IMPLANTED BUBBLE-DOMAIN FILMS

Moscow MIKROELEKTRONIKA in Russian Vol 14, No 6, Nov-Dec 85 (manuscript received 13 Aug 84) pp 501-511

[Article by Yu. G. Lebedev, Ye. I. Rayevskiy, Yu. K. Milyayev, and V. Ya. Rayevskiy, Institute of Metal Physics, Ural Scientific Center, USSR Academy of Sciences]

[Abstract] A theoretical study is made of the remagnetization of ion-implanted bubble-domain films in order to compute the magnitudes of the magnetic fields and currents needed to produce magnetic domains. The transitional layer that forms on the boundary of an exchange-coupled film is found to change the nature of remagnetization of the film: Remagnetization of an ion-implanted film results from the occurrence of instability in the transitional layer and the formation of a domain wall followed by shifting to the magnetic-domain layer. Under certain conditions, this process reduces the magnitudes of the remagnetization fields several-fold. It can be expected that ion-implanted films will require critical currents for producing cylindrical domains that are 1.5-2 times smaller than for non-implanted films. Figures 6; references 11: 3 Russian, 8 Western.

6900/5915
CSO: 1860/184

MICROWAVE THEORY AND TECHNIQUES

UDC 621.385.69

BUILDUP OF SELF-EXCITED OSCILLATIONS IN ELECTRONIC MICROWAVE OSCILLATORS WITH DIFFRACTION RADIATION OUTPUT

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 1, Jan 86 (manuscript received 4 Sep 84) pp 106-114

[Article by N. S. Ginzburg, N. A. Zavolskiy, G. S. Nusinovich and A. S. Sergeyev, Institute of Applied Physics, USSR Academy of Sciences]

[Abstract] A self-consistent system of equations of excitation and equations of motion is derived for the description of transient processes in microwave oscillators with electron-beam excitation and diffraction radiation output. The equations of excitation transients in such an electrodynamic system are obtained from the wave equation, its solution here representing a series of modes in a "cold" waveguide not completely filled with the electron beam. The equations of electron motion in a high-frequency field are different for different devices. Transients in a gyrotron near the cutoff frequency are considered, assuming for the purpose of analysis that only one mode is in synchronism with the electron beam and excitation of all other modes is negligible. Initial and appropriate boundary conditions are stipulated for the corresponding parabolic equation of excitation, including a boundary condition for the radiation. The solution to this equation for a gyrotron with floating longitudinal field structure describes the evolution of its high-frequency field. Numerical calculations have been made first for an "empty" resonator, without an electron beam, then for a gyrotron operating at a large frequency mismatch $\Delta = -0.6$ with the electrons and the opposing wave at cyclotron resonance. The authors thank M. I. Petelin and A. D. Yunakovskiy for interest and helpful comments. Figures 5; references: 11 Russian.

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UDC 538.566:621.377.22

APPROXIMATE PERFORMANCE CALCULATIONS FOR MEANDROUS STRIP LINES

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 22 May 85) pp 65-68

[Article by M. I. Veselkov, V. V. Rogozin and S. A. Tretyakov]

[Abstract] A simple approximate method is proposed for calculating the transmission coefficient of meandrous multiconductor strip lines over a multioctave frequency range. It is based on the conventional transmission line equations, taking into account the finite length and the interaction of adjacent conductors only. The inhomogeneity at the junctions between adjacent conductors, characterized by a buildup of charge at the bends, is represented by an equivalent capacitance. A slow wave is assumed to propagate along the structure, with a constant phase shift from one inhomogeneity to the next. A unity transmission coefficient corresponds to a matched structure. Theoretical calculations by this method for a typical meandrous strip line agree with its measured frequency characteristic, except that dissipative losses not included in the calculations widen the rejection bands. Figures 3; references: 6 Russian.

2415/5915
CSO: 1860/201

UDC 621.372.553

THEORETICALLY ATTAINABLE CHARACTERISTICS OF SOME ELECTRICALLY CONTROLLED ATTENUATOR STRUCTURES

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 24 May 85) pp 69-71

[Article by V. N. Ilyushenko]

[Abstract] A comparative performance evaluation has been made of twelve different electrically controlled attenuators on microstrip lines, consisting of p-i-n diodes in T or II configurations without or with corrective lumped inductance or capacitance or both. Their amplitude-frequency and phase-frequency as well as attenuation range and voltage standing-wave ratio have been calculated on a digital computer, using a linear equivalent circuit of a p-i-n diode and with the elements of the transmission matrix normalized to the source impedance and the load impedance. The operating frequency range is 0-0.2 f_0 for six of these attenuators and 0-0.2f_0 or 0-0.4f_0 for the other six (f_0-resonance frequency of p-i-n diode), T and II connections of the diodes being equivalent in terms of performance. The author thanks I. A. Kolesov for helpful discussion. Figures 2; tables 1; references: 3 Russian.

2415/5915
CSO: 1860/201

UDC 621.396.677.32:621.396.677

METHOD OF SYNTHESIZING EFFICIENT SURFACE-WAVE EXCITER

Moscow RADIOTEKHNIKA in Russian No 1, Jan 86
(manuscript received after revision 26 Mar 85) pp 72-74

[Article by G. A. Yerokhin, V. G. Kocherzhevskiy and V. G. Gofman]

[Abstract] A wideband exciter of surface waves is synthesized which combines high efficiency with small size and close matching. The problem is to determine the geometry of the exciter cavity region and the boundary conditions at its walls. This is done for a horn exciting a unidirectional surface magnetic wave, with a straight-waveguide feeder at its entrance throat. The distribution of the field of the waveguide modes is found by the method of decaying images. The efficiency of such an exciter $2\lambda_0$ long with a costal retarding structure, built for and tested with a modulated impedance antenna with low level of fringe radiation, has an efficiency of at least 93% and a traveling-wave ratio of at least 87% over the 7.5-10.5 GHz frequency range. Figures 2; references: 3 Russian.

2415/5915
CSO: 1860/201

UDC 621.317.74:621.3.089.14:621.37/.39

HIGH-PRECISION UNIT FOR CERTIFYING THE MAGNITUDE OF THE REFLECTION FACTORS OF RADIO MATERIALS IN THE 1-3 GIGAHERTZ FREQUENCY RANGE

Moscow IZMERITELNAYA TEKHNIKA in Russian No 12, Dec 85 pp 39-40

[Article by G. A. Vedoshkin, A. I. Svarovskaya, P. P. Talko-Grintsevich, and M. G. Chernyshev]

[Abstract] Precise measurement of the reflection factor of electromagnetic waves in the microwave range from materials and the natural environment is considered in connection with radar systems, the increase of sensitivity of receiving units, and the appearance of special-purpose low-reflection materials and coatings. The basic conditions of the theory of the compensation-dynamic method of measuring the reflection factor and methods of certification and construction of high-precision installations are studied in connection with the UVT 19-84 unit realized at the Siberian State Scientific Research Institute of Metrology in 1983. In the process of creating the unit to obtain higher precision of the magnitude of the reflecting factor of materials, the MI391-83 measurement method was developed and is being applied for the compensation-type measurement equipment. Figures 2; references: 9 Russian.

6415/5915
CSO: 1860/177

UDC 621.382

MILLIMETER-BAND GUNN DIODES EMPLOYING HONEYCOMB STRUCTURES

Moscow MIKROELEKTRONIKA in Russian Vol 14, No 6, Nov-Dec 85
(manuscript received 24 Apr 84) pp 517-520

[Article by V. I. Borisov, A. L. Galanin, V. A. Korobkin, V. Ye. Lyubchenko, and C. Ye. Moroz, Institute of Electrical Engineering and Electronics, USSR Academy of Sciences]

[Abstract] Gunn diodes based on honeycomb structures with contact (window) diameter of 8 μm and active regions 2.3 μm thick produced from an epitaxial film of gallium arsenide on a highly doped substrate were investigated. The ohmic contacts were produced by applying films of gold and gold alloys. The voltage-current characteristics of specimens subjected to direct current and microwave fields at 36 and 75 GHz were compared. The diode resistance as a function of the bias in the magnetic field was investigated. The voltage-current characteristics and differential conductivity in longitudinal and transverse magnetic fields were analyzed. The relationship between the oscillating frequency and the longitudinal magnetic field was compared for different bias voltages. A honeycomb Gunn diode structure was found to be convenient in operation and to support continuous mode operation. By improving heat removal through the substrate, it will be possible to increase the contact diameter and to raise the oscillating power to a level sufficient for a number of microwave devices, such as receiver heterodynes. It is found possible to increase the negative differential conductivity of diodes at microwave frequencies through the formation of static domains, which can be used in frequency conversion and signal detection. Figures 4; references 10: 5 Russian, 5 Western.

6900/5915
CSO: 1860/184

UDC 534.232

SURFACE ACOUSTIC WAVE REFLECTION IN TYPE ΔV/V WAVEGUIDE WITH PERIODICALLY VARYING WIDTH

Moscow MIKROELEKTRONIKA in Russian Vol 14, No 6, Nov-Dec 85
(manuscript received 1 Feb 85) pp 562-563

[Article by Yu. V. Gulyayev, O. A. Maltsev, and A. V. Medved, Institute of Electrical Engineering and Electronics, USSR Academy of Sciences]

[Abstract] An experiment was conducted to study the reflection of surface acoustic waves in a ΔV/V waveguide with periodically varying width. A surface acoustic wave resonator with two inputs was investigated, with reflecting structures consisting of waveguides with periodically varying width. The waveguides and interdigital converters were prepared from an aluminum film

applied to a YZ-cut $LiNbO_3$ substrate. The amplitude-frequency characteristic, and the frequency response of the coefficient of reflection of the reflecting waveguides were studied. It was found that a $\Delta V/V$ waveguide with periodically varying width, whose parameters can easily be controlled during the fabrication process, can serve as a reflecting structure for surface acoustic waves. The dimensions of the device can be kept extremely small for any apodization of the reflecting structures. The coefficient of reflection is governed mainly by the dispersion characteristic of the waveguide. Figures 2; references 4: 1 Russian, 3 Western.

6900/5915
CSO: 1860/184

UDC 535.825.3

STUDY OF FIELD DISTRIBUTION IN OPEN CAVITY OF WORKING DIFFRACTION RADIATION GENERATOR

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 12, Dec 85 (manuscript received 13 Sept 84) pp 1576-1582

[Article by V. K. Korneyenkov, V. S. Miroshnichenko and V. P. Shestopalov, Institute of Radiophysics and Electronics, Ukrainian SSR Academy of Sciences]

[Abstract] The field distribution in the open cavity of a working diffraction radiation generator is investigated using a special system designed to permit free access to the cavity. A method is described for registering the microwave field amplitude using thermochemical paper. The investigations were made in the long-wave portion of the millimeter band. The investigation of the field distributions made it possible to perform a detailed analysis of the physical features of the operation of the generator. By using thermochemical paper to visualize the microwave fields in the cavity, it is possible to identify the types of modes excited in the cavity, as well as to select optimal working modes and suppress higher modes. The relationships between the amplitudes of the waves near the periodic structure and in the cavity that are needed for calculating the output characteristics of the diffraction radiation generator are established. Figures 5; references: 4 Russian.

6900/5915
CSO: 1860/175

UDC 537.633

SPACE-FREQUENCY DEPENDENCES ON ENERGY FLUX OF MAGNETOSTATIC SURFACE WAVE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85
(manuscript received 15 May 84) pp 2422-2428

[Article by A. V. Vashkovskiy, K. V. Grechushkin and A. V. Stalmakhov]

[Abstract] An analysis is made of the behavior of the energy flux of a magnetostatic surface wave propagated in a ferrite film with various directions of the wave vector relative to the magnetic field, as well as of the behavior of the energy flux in various regions of the waveguide structure. Theoretical studies were made, not only of the dependence of the direction of the flux, but also of the rate of energy transfer. It was found that for a fixed direction of the wave vector there are sectors of possible directions of the total energy flux of the magnetostatic surface wave and of the energy flux in the ferrite component of the structure. Experimental studies were made of the deviation of the energy flux from the direction of the wave vector. A constant-frequency microwave signal was supplied by an oscillator to the input of the model, containing a film of yttrium-iron garnet. The signal passing through the model entered the input of a measuring receiver. The model was placed in a constant magnetic field of 870 Oe created by an electromagnet. The films were in the shape of half-disks with a diameter of not less than 40 mm to eliminate the dimensional effects associated with the finite dimensions of the ferrite film. The films were 10 μm thick and the magnetostatic surface wave was excited by means of a microstrip antenna with a 4-mm aperture. The waves were received by a folded-dipole probe which was moved by a microscrew so that it was possible to place it at any point on the film's surface and the orientation of the plane of the folded dipole could be varied relative to the input transducer. Experimental data are presented on the direction of the energy flux of the wave versus the frequency of the signal in the region of existence of the wave for three directions of the wave vector. The amount of deflection of the energy flux from the wave vector increases with an increase in frequency. At a fixed frequency, the amount of deflection of the direction of the energy flux increases with a reduction in the angle between the wave vector and the z axis along which the magnetic field is directed. It was demonstrated that with wide angles between the energy flux and the wave vector the spatial beam width of the wave can be reduced considerably, which is of great practical importance. The calculation of energy fluxes of the wave in various regions of the waveguide structure explains the physics of processes of magnetostatic surface wave propagation for the case of a random direction of the wave vector. Figures 5; references 7: 2 Russian, 5 Western.

8831/5915
CSO: 1860/187

UDC 357.533.72:537.634:621.385.6

DYNAMICS OF RELATIVISTIC ELECTRON STREAM IN BENDING AND FOCUSING MAGNETIC FIELDS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 12, Dec 85 (manuscript received 10 May 84) pp 2442-2449

[Article by D. M. Benevolenskiy and V. D. Trebich]

[Abstract] The results are presented of a theoretical study of the influence of various types of focusing magnetic fields on the motion and bunching of a relativistic electron stream in a bending magnetic field which is of current interest for microwave electronics. Numerical modeling was performed on a computer. The method of bunching an electron beam in a bending magnetic field requires the achievement of a good path of current flow in the bending ring under static and dynamic conditions, necessitating the use of a focusing system. The focusing system must meet two contradictory requirements: assurance of the absence of spreading of the beam in the vertical direction, i.e., that of the transverse magnetic field; and simultaneous maintenance of the motion of electrons of various energies in circles of different radii, which produces the bunching effect. The dynamics of charged particles are calculated in a kinematic approximation based on numerical integration of the equation of motion. Focusing systems are evaluated from the viewpoint of enabling both a path of current flow and bunching. There are two velocity components--azimuthal and radial--in a buncher having a bending magnetic field. A numerical analysis demonstrated that strong focusing magnetic fields enable a good path of current flow for the modulated electron beam in the buncher's bending ring but considerably worsen the intensity of bunching. The use of a weak focusing system is ineffective from the viewpoint of enabling a path of current flow in the bending ring. The use of a constant azimuthal magnetic field results in spreading of the beam in the vertical direction and in sharp worsening of bunching. The employment of an alternating-sign azimuthal magnetic field results in a periodic change in the direction of the radial Lorentz force, which has a favorable influence on bunching intensity. Based on an analysis of the physics of the processes involved, it is shown that focusing by means of an alternating-sign azimuthal magnetic field is preferable, for it enables steady motion of the electron beam in the bending ring with the required bunching intensity level. The results of numerical calculations agree well with results obtained analytically. With an alternating-sign azimuthal magnetic field satisfactory results were obtained both with stepwise and sinusoidal patterns for variation of the focusing magnetic field. With an appropriate choice of the parameters of the alternating-sign focusing system, i.e., with specific relationships between the number of periods of the azimuthal field and the absolute value of the direction of the azimuthal magnetic field, it is possible to reduce the power of the input signal by 30 to 45 percent while increasing bunching intensity. The analytical relationships obtained can be used to make estimate calculations for a buncher utilizing a bending magnetic field with an alternating-sign azimuthal magnetic field and a beam of finite dimensions. Figures 5; references 6: 5 Russian, 1 Western.

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CSO: 1860/187

UDC 621.313.333.012.6.001.24

NEW METHOD FOR CALCULATING TORQUE CHARACTERISTICS OF ASYNCHRONOUS MOTORS WITH STRAIGHT GROOVES

Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 85 (manuscript received 11 Jan 85) pp 36-39

[Article by Candidate of Engineering Sciences P. G. Popov and Doctor of Engineering Sciences Yu. A. Shumilov, Kiev Polytechnical Institute]

[Abstract] This study extends and implements a method proposed earlier by the authors for calculating the electromagnetic starting parameters of asynchronous motors in which numerical calculation of the field (by the finite-element difference) in the cross-section of the active part is combined with tradional analytical calculation of the face-ring leakage flux. A series of numerical experiments using models with differing degree of idealization were conducted. The mean square deviations of the calculated starting indicators comprise 5.7% for the starting current and 5.0% for the starting torque for 12 motors, indicating that the algorithm can be recommended in spite of the significant machine time required for exact prediction of starting indicators. Figures 2; tables 2; references: 6 Russian.

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CSO: 1860/186

UDC 551.46.09:621.221

STATUS AND PROSPECTS OF WAVE POWER

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 12, Dec 85 pp 3-9

[Article by Candidate of Engineering Sciences V. I. Sichkarev, Far East Higher Engineering Marine Training School imeni Admiral G. I. Nevelskiy]

[Abstract] The current status of the exploitation of the power contained in waves at sea is reviewed. Expressions are cited for estimating the energy flux by zones of the oceans around the world. The properties inherent in wave activity that can be exploited for gathering energy are examined. Designs that have been proposed for wave energy stations around the world are reviewed. An analysis of the relationship between the relative cost of wave power and the

sophistication of the wave station reveals a near-linear connection between the upper and lower bounds of the cost of the energy and the sophistication of the station. No existing design is found to yield power at a competitive rate; however, it is predicted that large industrial wave power stations will appear by the end of the century. Figures 2; tables 1; references 8: 5 Russian, 3 Western.

6900/5915
CSO: 1860/181

UDC 621.311:681.3.06

MICROPROCESSOR-BASED INFORMATION SUPPORT FOR POWER SYSTEMS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 12, Dec 85 pp 10-13

[Article by Doctor of Engineering Sciences, Professor V. A. Venikov, Moscow Power Engineering Institute, Doctor of Engineering Sciences, Professor Yu. V. Shcherbina, Kiev imeni 50th Anniversary of the October Socialist Revolution Polytechnical Institute, and Candidate of Engineering Sciences docent V. S. Kakhanovich, Belorussian Polytechnical Institute]

[Abstract] The transition to a uniform information support system for power engineering based on networks of microprocessors and microcomputers is discussed. The first task is to develop electronic pulse counters for electrical and heat energy that provide improved measurement accuracy and a high data rate. Sufficient research, design, and production teams must become involved in order to solve the methodical, engineering, and algorithmic problems involved in creating new information systems. Orienting the development of power engineering in the USSR toward a unified system for providing information support for control processes based on a distributed network of microprocessors and microcomputers will become a basic area for the qualitative transformation of the material and technical base of the power engineering industry, and will thus accelerate national social and economic development. References: 9 Russian.

6900/5915
CSO: 1860/181

UDC 621.31.003:631.371

LONG-RANGE FORECASTING OF EXPANDED ELECTRIFICATION OF PRODUCTION BASED ON DYNAMIC MODEL

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 12, Dec 85 pp 19-23

[Article by G. M. Beregova, Irkutsk Polytechnical Institute]

[Abstract] A dynamic modeling method is proposed for long-range estimation of power consumption that makes it possible to construct a model that reflects adequately the internal structure of the power consuming system. A systems approach is employed in which the model reflects the most essential relationships between the electrification parameters and the basic parameters of economic growth and technical progress. The model makes it possible to derive a number of alternate forecasts based on different hypotheses with respect to the assigned indicators. The analysis reveals a close connection between electrification parameters and economic growth indicators. In validating the model, the results were found to be inadequate with respect to some endogenic indicators such as gross production; it was determined that the exogenic variables in the model which had influenced these indicators were not sufficiently validated from the scientific viewpoint. The proposed dynamic model was found to be suitable for making long range calculations of industrial power consumption. Figures 3; tables 1; references: 3 Russian.

6900/5915
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UDC 658.011.4:621.311

OPTIMIZATION OF STRUCTURE OF GENERATING CAPACITIES OF POWER SYSTEM OF REPUBLIC OF CUBA BY MEANS OF LINEAR MATHEMATICAL MODEL

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 12, Dec 85 pp 24-31

[Article by G. R. Galyano and E. Delgado, Engineers, and Candidate of Engineering Sciences L. D. Khabachev, Leningrad Polytechnical Institute imeni M. I. Kalinin]

[Abstract] A linear mathematical model is proposed for investigating the conditions underlying the formation of the structure of the generating capacities of the power system serving the republic of Cuba. The model makes it possible to identify the proper integrated amount of capacity at new nuclear power plants and at the new hydroelectric pumped storage power plants that must be built in the republic of Cuba to support the basic operating modes of nuclear power plants. The model is found to be an effective tool for investigating the rational structure of generating capacities in the power system considering ambiguity of the initial conditions for the long-range development of power

generation. Linear as well as dynamic nonlinear stimulation-type models of different types must be used to validate specific recommendations on the development of generating capacities in the Cuban power system. References: 2 Russian.

6900/5915
CSO: 1860/181

UDC 621.316.172:338

FORECASTING DAILY ELECTRICAL LOAD SCHEDULE FOR MUNICIPAL CONSUMERS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 12, Dec 85 pp 41-43

[Article by Candidate of Economic Sciences, docent, A. G. Saidkhodzhayev, Tashkent Polytechnical Institute imeni A. R. Beruni]

[Abstract] The indicators that characterize the electrical load schedules of municipal consumers are analyzed. An expression is derived for determining municipal power consumption as a function of the installed capacity, the size of the population, the volumes of the conditional units of the municipal networks served, and the power consumption level by years. The parameters of the long-range electrical load schedules are determined by mathematical statistical methods, using typical daily schedules developed on the basis of actual schedule measurements made since 1970. An analysis of the results indicated that the daily gap in the long-range schedule of the power system is filled through the use in public and residential buildings of air conditioning installations, food preparation equipment, and different types of power consuming devices in municipal networks. Forecasting of electrical load schedules, and the factors that influence changes in the long-range schedule, makes it possible to identify the most effective and rational ways to fill out the combined daily load schedule of the power system that corresponds to energy conservation policy. Figures 1; tables 1; references: 2 Russian.

6900/5915
CSO: 1860/181

UDC 621.316.25

MAGNETIC FIELD OF MINE CABLE IN DAMAGE TRACING

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 12, Dec 85 pp 50-53

[Article by Candidate of Engineering Sciences V. V. Pavlovets and Engineer V. I. Lakin, Belorussian Polytechnical Institute]

[Abstract] A method is presented for calculating the magnetic field around a mine cable in order to localize damage. Graphs are constructed for the change in the field inductance on the surface of the jacket of a mine cable, and at a distance from that surface. The magnetic field induction is found to be distributed irregularly around the cable, with the irregularity dropping off rapidly as the distance from the axis of the cable increases. A device developed at the Belorussian Polytechnical Institute for localizing damage is described that incorporates two loop sensors connected in opposite directions and separated by the amount of the twist pitch of the cable conductors. Figures 3; references: 3 Russian.

6900/5915
CSO: 1860/181

QUANTUM ELECTRONICS, ELECTRO-OPTICS

UDC 533.9.08:541.182.2/3

NON-CONTACT METHODS OF STUDYING PARTICLE PARAMETERS IN TWO-PHASE PLASMA FLOWS

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 53, No 6, Jun 85
(manuscript received 27 Jul 84) pp 1015-1028

[Article by V. V. Krasovskiy, A. L. Mosse, V. I. Tyukayev and I. P. Polyakov, Institute of Heat and Mass Transfer im. A. V. Lykov, Academy of Sciences, Belorussian Socialist Soviet Republic, Minsk; Institute of Nonorganic Chemistry, Academy of Sciences, Latvian Soviet Socialist Republic, Riga]

[Abstract] On the basis of 70 articles from the Soviet Literature a review is presented of holographic and laser-optical devices and optical pyrometers for contactless analysis of the dynamics of multiphase plasma systems with applications in atomic power engineering, rocketry and aviation, chemical engineering and meteorology. Procedures are discussed for: 1) Determination of the dispersed composition and concentration of solid phase particles in gas flows; 2) Determination of speed of particles in two-phase flow; and 3) Determination of temperature of particles in two-phase flow. Figures 12; references: 70 Russian.

6415/5915
CSO: 1860/188

UDC 532.526.4:535-15:536.241

HEAT AND MASS TRANSFER IN OPTICALLY THIN TURBULENT BOUNDARY LAYER IN AN INFRA-RED RADIATION FIELD

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 55, No 6, Jun 85
(manuscript received 10 Oct 83) pp 885-894

[Article by A. I. Leontev, A. I. Pavlyuchenko and N. A. Rubtsov, Moscow Higher Technical School imeni N. E.Bauman; Institute of Theoretical and Applied Mechanics; and Institute of Thermophysics, Siberian Department of the Academy of Sciences, Novosibirsk]

[Abstract] The procedures used and the results obtained are presented for an experimental investigation of the following: 1) Measurement techniques, metrological characteristics of transducers, and profiles of velocity and temperature in an incompressible turbulent boundary layer of air in an infrared radiation field; 2) Measurement of velocity and temperature fields in

optically thin turbulent boundary layer of CO_2 in an infra-red radiation field; and 3) Heat and mass transfer in an infra-red radiation field with tangential and porous injection of air and CO_2 into a turbulent boundary layer. The authors thank Academician S. S. Kutateladze for supporting the work and for fruitful discussion. Figures 5; references 41: 36 Russian, 1 Western in translation, and 4 Western.

6415/5915
CSO: 1860/188

UDC 621.372.833

SIGNAL DISTORTIONS DURING INTERFACING OF SEMICONDUCTOR LASER AND FIBER OPTIC COMMUNICATIONS LINE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 29, No 1, Jan 86 (manuscript received after revision 12 May 85) pp 75-77

[Article by D. V. Kizevetter and V. I. Malyugin]

[Abstract] Signal distortions occurring due to change in the laser radiation pattern when the laser is interfaced with a fiber optic line are investigated. The power emitted by a 32DL10ID laser and input to a gradient light guide is investigated experimentally for different laser pumping currents. Change in the radiation pattern of the laser is found to have a strong influence on analog transmission. Nonlinearity of the input response caused by change in the radiation pattern when the pumping current is modulated can be significant (reaching approximately 50%), and often dominate other mechanisms that underlie distortions. Figures 3; references: 4 Russian.

6900/5915
CSO: 1860/202

UDC 621.373.836:621.396

ASSESSMENT OF OPERATING PERFORMANCE OF MULTIELEMENT FIBER OPTIC SENSORS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 29, No 1, Jan 86 (manuscript received after revision 7 Jun 85) pp 78-79

[Article by L. L. Barvinskiy, K. Ya. Lizhdvoy, V. A. Svirid, and S. N. Khotyaintsev]

[Abstract] A fiber optic liquid level sensor is investigated that consists of a system of sensing elements arranged linearly one above another. The fiber optic light guides connect the elements to the electronic unit that polls the elements and processes the data. The effectiveness of the system is estimated on the assumption that the sensor is a brief-acting system and that the probability of two or more elements failing simultaneously is negligibly small.

The effectiveness of a multielement fiber optic sensor is found to be higher than that of an analogous device incorporating a single long element with the same reliability as one discrete element of the multielement device. Figures 1, references: 4 Russian.

6900/5915
CSO: 1860/202

UDC 621.373.026

EFFECT OF TRANSVERSE LASER MODES ON TIME COHERENCE OF RADIATION PASSING THROUGH OPTICAL FIBER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 12, Dec 85 (manuscript received 17 Oct 84) pp 50-51

[Article by T. Akhmadzhanov and A. T. Mirzayev

[Abstract] An experimental study was made pertaining to the dependence of the time coherence of laser radiation on its model content, particularly on transverse modes. Radiation was generated by an LG-56 He-Ne laser with transverse microwave-discharge excitation, first containing only longitudinal modes and then containing also several transverse modes. The radiation was in each case let through a microobjective into a 150 m long loop of optical fiber with a 50 μm effective diameter and a 0.2 numerical aperture. The light beam coming out of the fiber was widened by another microobjective and then split by a semitransparent mirror for subsequent interferometry with the aid of two other mirrors and a photodetector. Random interference of fiber modes was minimized by means of a diaphragm smaller than a speckle. The number of longitudinal modes was monitored by means of another interferometer. For comparison, the time correlation function of laser radiation was also measured directly without passage through an optical fiber. The fiber was found to decrease the time correlation function, evidently owing to lower space coherence. Existence of transverse modes in the radiation was found to decrease its time correlation function even more, evidently owing to the noncorrelation of these modes with phase fluctuating over the $0-2_{\pi}$ range. Figures 2; references 3: 1 Russian, 2 Western.

2415/5915
CSO: 1860/194

UDC 621.378.325:681.327

INSTRUMENT FOR VISUALIZATION AND MONITORING OF GENERATION SPECTRA OF CO_2 LASERS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 12, Dec 85 pp 11-12

[Article by V. N. Antipov, I. S. Fishman, and V. V. Chizhov]

[Abstract] A device is described with which it is possible simultaneously to obtain the spectral and time resolution of the radiation spectrum of a CO_2 laser. It is also possible to use the device to determine pulsations of the total capacity of a laser in operating time. The circuit and principles of operation of the device are cited. The device makes it possible to identify, visualize, register, and process the generation spectrum of oscillatory-rotary junctions of the series electric discharge CO_2 lasers LG-25, 43, 23, ILGN-704, and experimental technological units. With small changes introduced in order to decrease inertia of the amplifying channel, and connection of a spectroanalyzer (in the area of operation to 100 MHz), use of this instrument in one of its operating regimes makes it possible to determine the mode makeup of CO_2 laser radiation. Figures 2; references: 6 Russian.

6415/5915
CSO: 1860/177

UDC 681.7.543.422.23.08:081.3

OPTICAL DISPLACEMENT SPECTROMETER IN COMPLEX WITH MICROCOMPUTER

Moscow IZMERITELNAYA TEKHNIKA in Russian No 12, Dec 85 pp 33-34

[Article by Yu. F. Kiyachenko, L. M. Kotlov and Yu. I. Litvinov]

[Abstract] An installation is considered, developed on the base of a spectrometer described in a 1981 article by Yu. F. Kiyachenko and I. K. Yudin. The spectrometer operates in a complex which includes a Type LG-79-1 He-Ne laser (λ = 633 nm) and an Elektronika-NTs-3D microcomputer. The results are presented of an experimental study concerned with measurement of the viscosity of glycerine with respect to diffusion of Brownian particles. Figures 2; references 5: 3 Russian, 2 Western in Russian translation.

6415/5915
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MEASUREMENT OF PROFILE OF INDEX OF REFRACTION OF OPTICAL FIBERS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 85
(manuscript received after revision 22 May 85) pp 4-9

[Article by S. D. Mirovitskaya and D. L. Kudryatsev]

[Abstract] A theoretical assessment is made of the possibility of measuring the index of refraction on a transparent dielectric cylinder with diameter exceeding the width of the radiating beam; the problem of refraction of a narrow beam in a circular dielectric cylinder is solved for the types of profiles encountered most frequently--elliptical, parabolic, and center-trap. By measuring the angle of refraction of the narrow sounding beam, it is possible to find the parameters of the optical fibers and the distance from the axis of the cylinder to the focal point of the light beam. An accuracy analysis indicated that the profile of the index of refraction for multimode optical fibers with diameter exceeding 50 μm can be found to within at least 10%, and to within at least 4% for blanks 500-2000 μm in diameter. Figures 4; tables 3; references 11: 5 Russian, 6 Western.

6900/5915
CSO: 1860/183

UDC 535.317.2

HIGH-RESOLUTION PROJECTION LENSES BASED ON DIFFRACTION LENS

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 5 May 85) pp 3-7

[Article by S. T. Bobrov and G. I. Greysukh]

[Abstract] The use of diffraction lenses to fabricate high-resolution projection lenses is analyzed. Diffraction lenses, which are zone-plate type optical elements consisting of concentric annular grooves that exhibit focusing properties due to diffraction, are found to differ widely from their refraction analogs. The spherical aberration can be controlled by changing the order of the annular grooves in the structure; the coefficients of the field aberration series of axial diffraction lenses coincide. By the same token, diffraction lenses exhibit significant chromatic aberrations. Optical information processing systems are found to be one of the most promising areas for the use of diffraction objectives, inasmuch as lasers serve as the light source in most cases, and the object in these systems are usually characterized by small space factors, so that the deficiencies of diffraction elements are overcome entirely by the useful properties of diffraction lenses and optical systems based on them, such as low weight, reproducibility, stability of characteristics, and the possibility of copying and reproducing elements. Figures 4; references 10: 8 Russian, 2 Western.

6900/5915
CSO: 1860/182

UDC 535.4:778.38

ROTATING PHASE-ONLY SYNTHETIC FOCUSING HOLOGRAM

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 7 May 85) pp 7-12

[Article by G. A. Lenkova]

[Abstract] The possibility is investigated of creating a phase-only synthetic reflecting hologram that combines the functions of two optical elements, one of which deflects the light beam through the required angle, and the other of which focuses it on a photosensitive material, screen, etc. The zone topology is calculated for a phase-only synthetic hologram element that rotates the light beam and simultaneously performs an aberration-free point image of the source. Recommendations presented regarding the use of the approximate formulas derived to calculate the zone topology of an oblique synthetic hologram element in focusing a parallel light beam also hold for mapping a point source to a point image. Figures 4; tables 1; references: 2 Russian.

6900/5915
CSO: 1860/182

UDC 535.4:778.38

LONG-FOCUS CYLINDRICAL PHASE-ONLY SYNTHETIC HOLOGRAM LENSES FOR MONOCHROMATIC ILLUMINATION

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 17 Jun 85) pp 12-16

[Article by V. P. Petrov, I. S. Soldatenkov and S. I. Soskin]

[Abstract] Two types of long-focus phase-only synthetic hologram cylindrical lenses were investigated for use with a parallel monochromatic light beam: axial and nonaxial. The optical characteristics of the lenses were investigated experimentally. The calculated and experimental diffraction efficiency was compared. The results indicated that synthetic hologram cylindrical lenses with small relative apertures (approximately 1:60) can be fabricated at a high technological level and used to develop long-focus optical systems. These elements can be combined with spherical lenses to obtain wide-aperture anamorphotic refraction-diffraction systems that are difficult to obtain by traditional optical methods. Figures 4; tables 2; references 5: 3 Russian, 2 Western.

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COMPENSATED SPHERICAL SURFACES IN OPTICAL SYSTEMS

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 5 May 85) pp 23-26

[Article by S. T. Bobrov]

[Abstract] This study examines the use of diffraction lenses in combined lenses that also incorporate refraction components such that the latter are wide-aperture and the diffraction lenses have a norrow aperture and perform correcting functions. This makes it possible to provide chromatic correction and to increase the contrast of the image. A spherical refracting surface in combination with a diffraction lens is analyzed with no a priori conditions on the focal length of the diffraction lens or the distance between the apex of the spherical refracting surface and the diffraction lens. Conditions are identified under which the combined component exhibits aplanatic properties in the region of third-order aberrations. A symmetrical combined lens scheme incorporating two refraction menisces with equal radii and two diffraction aspherics is analyzed as an example. Compensated surfaces make it possible to obtain optimizable initial schemes with initial parameters sufficiently close to those optimized. Figures 2; references: 7 Russian.

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COMBINATION OF DIFFRACTION AND REFRACTION COMPONENTS IN OPTICAL SYSTEMS

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 24 Jun 85) pp 27-31

[Article by A. G. Poleshchuk]

[Abstract] A method is presented for combining (centering) diffraction optical elements in relation to other elements in an optical system that is simple and highly precise. The method can also be used for aligning masks in fabricating diffraction elements by photolithography. The method is based on the fact that several diffraction structures, each of which converts the light flux according to a specified principle, can be created on the same substrate; the relative positions of the structures (such as their centers of symmetry) can be maintained to within approximately 0.1 μm. An experiment is described in which the alignment of a spherical lens with a focal length of approximately 150 mm and a glass plate with a thermochemically-applied annular zone containing a Fresnel region is studied. The theoretical and experimental alignment figures were in good agreement. The proposed method makes it possible to align the centers of symmetry of a spherical lens and aberration-correcting diffraction optical lenses to within 0.1-1 μm to align several diffraction elements arranged

in series with the optical axis, and to align masks for photolithographic preparation of individual diffraction elements (phase-only synthetic holograms), as well as diffraction correctors. Figures 3; references 5: 4 Russian, 1 Western.

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INTERFERENCE DIAGNOSIS OF PLANAR OPTICAL WAVEGUIDES

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 18 Oct 84) pp 70-75

[Article by Yu. P. Udoyev]

[Abstract] An investigation is made of the causes of the interference picture that occurs in reflected light when a planar optical waveguide is illuminated from the bearing layer side by a system of diverging light beams in the region of complete internal reflection. Analytical conditions are derived for the interference minima that can be used for follow-on processing of measurements of their angular position. It is found that the fine structure of the spatial Fourier spectrum of the radiation reflected from a real waveguide in the region of complete internal reflection from the substrate is governed essentially by the interference phenomena in the bearing layer; measurement of its angular position makes it possible to calculate the characteristics of planar optical waveguides. It is concluded that the method can be used to investigate planar optical waveguides with attenuation exceeding approximately 1 dB/cm, which is acceptable for many real optical waveguides. It is theoretically possible to automate the diagnostic procedure by placing a one-dimensional array of photodetectors in the focal plane and employing computer interface devices. Figures 4; tables 1; references 9: 6 Russian, 3 Western.

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SYSTEM FOR RECORDING AND PROCESSING OPTICAL SIGNALS BASED ON CCD STRUCTURES AND ELEKTRONIKA 60 M MICROCOMPUTER

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 12 Jan 84) pp 76-80

[Article by I. A. Vodovatov, M. G. Vysotskiy, V. Yu. Petrunkin, S. A. Rogov and V. G. Samsonov]

[Abstract] An optical signal processing and recording system based on charge-coupled devices and a microcomputer is proposed. The system, which is based on an Elektronika 60M microcomputer and a programmable CCD controller, is investigated experimentally. The functional diagrams of the CCD controller and of the logic unit that sorts and determines the coordinates of the maxima are traced and explained. The systems software, which runs under the RT11-V04 real-time operating system, is described. The system has been used for digital optical signal processing tasks such as spectral analysis, pattern recognition, and optical modeling. Figures 3; references 7 Russian.

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MULTICHANNEL OPTOELECTRONIC CORRELATION-FUNCTION PROCESSOR

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 11 May 85) pp 80-84

[Article by V. I. Kozik, A. N. Oparin, and O. I. Potaturkin]

[Abstract] The possibility is investigated of improving pattern recognition accuracy through additional correlation function processing with the help of cellular operators. An optoelectronic processor is investigated experimentally that implements a process for recognizing the images of real objects that is invariant to foreshortening. The optoelectronic processor consisted of a holographic intensity correlator with a controlled transparency at the input and a television camera at the output, a cell generator, and an Elektronika 60 computer, all connected by a KAMAK highway. Two classes of real objects (industrial parts) were employed as processed images. The images were projected onto the transparencies where they were recorded and contoured, i.e., their silhouettes were converted to contoured figures. The holographic intensity correlator simultaneously output a set of 24 correlation functions. The system was able to recognize parts with different foreshortening, employing the correlation functions of the contoured processed and standard images as the similarity functions. It was shown possible to increase the ratio of the autocorrelation and cross-correlation samples at factors of 2-5 through additional digital processing at the output of the holographic intensity correlator. The optimal algorithms, from the viewpoint of increased recognition reliability, were determined experimentally. Figures 5; references 4: 3 Russian, 1 Western.

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METHOD FOR INCREASING CONTRAST IN CONTROLLED TRANSPARENCIES BASED ON PLZT

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 5 Jan 84) pp 85-87

[Article by B. V. Ulyanov]

[Abstract] A method is described for increasing contrast in transparencies based on lead lanthanum zirconate titanate (PLZT) that employs two PLZT plates arranged sequentially in the direction of travel of the beam. When a half-sample pulse strikes an element of the first plate, the light scattering decreases. If pulses of the half-sample strike the corresponding element of the second plate simultaneously, light scattering in the second plate is increased, compensating for the reduction in the first plate. The method was implemented experimentally using an 8/65/35 PLZT plate 0.2 mm thick containing In_2O_3-SnO_2 electrodes 1 mm wide, forming a matrix system. The amount of contrast provided as the polarization of the material was switched was measured. It was found that the proposed method increases the contrast severalfold in electrically controllable transparencies based on the effect of electrically controllable scattering. The relationship between the contrast and the degree of homogeneity of the electrical field in the region of the switched element requires that the element dimension be no smaller than the thickness of the PLZT plate. Figures 2; references 6: 2 Russian, 4 Western.

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COHERENT-OPTIC POWER-FACTOR INDICATION METHOD

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 85
(manuscript received 18 Jun 84) pp 98-103

[Article by A. N. Safronov and I. N. Troitskiy]

[Abstract] A method is proposed for measuring the phase component of coherent light fields that employs a space-time light modulator in the optical channel. The modulator transforms the phase front of the wave, and is controlled by a feedback signal that is formed during the recording and subsequent processing of the field intensity distribution in the image plane. The measurement device employs the structure of an adaptive dual-loop device that transforms the phase of the input field in order to maximize the signal energy in some contour in the image plane. Because the contour is formed continuously as the signal arrives, it is also possible to measure the phase in the case of a nonstationary object. The algorithm does not assume that the form of the object or the statistical characteristics of its reflecting surface are known exactly. Figures 1; references: 4 Russian.

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DYNAMIC HIERARCHICAL MODELING OF LSI DIGITAL DEVICES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 1, Jan 86 (manuscript received after revision 16 May 85) pp 8-12

[Article by V. G. Moshnyaga, Ye. M. Tikhomirova and V. T. Frolkin]

[Abstract] The method of adaptive modeling to verify LSI and VLSI circuit designs is extended to the top hierarchical design levels: System, functional and logical. The proposed adaptive multilevel hierarchical modeling strategy works by tracking the signals in the device and dynamically detailing the functioning of the subcircuits or circuit elements that are involved in signal conversion. An event modeling algorithm is proposed in which the modeling time is incremented by a variable interval whose size is regulated by the sequence of events in the circuit. The algorithm is found to be effective in that it permits logical analysis of the entire digital device with relatively small computer resources required. Because the adequacy of the dynamic hierarchical modeling is determined by the accuracy of the logical analysis, multi-valued logical modeling is proposed at the bottom hierarchical level to allow for spread in the delays of the elements. Figures 1; references 8: 4 Russian, 4 Western.

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METHOD AND ALGORITHM FOR CONFIGURING SCHEMATIC DIAGRAM OF DIGITAL DEVICE EMPLOYING MASTER SLICE APPROACH

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 1, Jan 86 (manuscript received after revision 15 Apr 85) pp 18-24

[Article by A. M. Merenkov and A. P. Panfilov]

[Abstract] A method and algorithm are proposed for the arrangement of a synthesized circuit on logic array master slices in order to configure a topological fragment of an LSI array. The base cell configuration derived by optimizing

the initial partitioning serves as the initial data for topological synthesis programs that perform placement and lead tracing. The program that implements the configuring algorithm is described. A version of the program for the Elektronika-60 computer is described that made it possible to reduce the required number of cells by 20% through more complete utilization of the master cell transistors. Configuring the schematic diagram of a four-bit adder required about 10 minutes of processing time on the Elektronika-60. Figures 3, references: 4 Russian.

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IDENTIFIABILITY ANALYSIS OF INTEGRATED-CIRCUIT ELEMENTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 12, Dec 85 (manuscript received after revision 25 Mar 85) pp 62-63

[Article by D. P. Bumarin]

[Abstract] A method is proposed for determining the integrated-circuit elements which can be identified with a given accuracy from circuit functions measurable at external output points. A node in the equivalent circuit is a point where two or more branches connect and every two nodes can be connected through only one branch with a generally complex admittance. The equivalent circuit is assumed to contain N branches, L elements, and M ungrounded nodes including K nodes accessible to measurement, all grounded nodes also being accessible. For determining what elements are identifiable within prescribed accuracy, the actual circuit is excited at one node with a sinusoidal current of given effective magnitude and the voltage drops across branches between accessible nodes are measured. The system of branch equations is set up in accordance with Ohm's law and Kirchhoff's first law, whereupon the nonzero impedance coefficients in the normalized matrix of these equations are calculated as rational-fractional functions of frequency. This procedure is repated after excitation of the circuit at every other accessible node, whereupon the matrix of all these systems of equations is set up. Subsequent extremization yields the values of unknown coefficients in that matrix which will make all equations of all systems simultaneous so that their solution will satisfy the circuit functions measured at the extrenal output points. The procedure is simpler when all nodes are accessible than when only two or several pairs of nodes are accessible. Solutions with all positive components are compatible with physical realizability of the given equivalent circuit, existence of zero or negative components calls for modification of the equivalent circuit. For illustration, the method is applied to the high-frequency equivalent circuit of an IC single-stage aperiodic amplifier. Figures 1; tables 1; references 2: 1 Russian, 1 Western (in Russian translation).

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SONICS AND ULTRASONICS

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NONLINEAR DISTORTIONS IN ACOUSTOOPTICAL DEVICES EMPLOYING OPTICAL HETERODYNE MIXING

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 1, Jan 86 (manuscript received after revison 9 Jan 85) pp 64-68

[Article by L. N. Preslenev and A. A. Stashkevich]

[Abstract] This study investigates the amplitude characteristics and dynamic range of devices in which the heterodyne optical beam is passed through an acoustical light modulator, such as acoustooptical delay lines, correlators, and other devices. The dynamic range is determined by the single-signal and two-signal methods. An acoustooptical delay line is analyzed as an example. Figures 2, references 10: 8 Russian, 2 Western.

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GENERATOR DYNAMO FOR ULTRASONIC TECHNOLOGICAL INSTALLATIONS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 12, Dec 85 (manuscript received after revision 24 Oct 85) pp 20-22

[Article by L. F. Kolomeytsev, G. A. Nazikyan and V. L. Kodomeytsev]

[Abstract] A rotary dynamo is described that produces single-phase sinusoidal current at 22 khz, with output power of 10 kW, rotor diameter of 300 mm, speed of 3000 rpm, idling voltage of 60 V, weight of 200 kg, and 78% efficiency. The consumption of active materials is reduced, and the reliability of the excitation winding is increased, by employing unipolar construction. The device was tested in an experimental system for ultrasonic cleaning of metal parts prior to electroplating. The device provides good operating reliability, is easy to maintain, and costs three to four times less than existing static sources with analogous parameters. References: 4 Russian.

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EFFECT OF CONSTANT ELECTRIC AND MAGNETIC FIELDS ON CHARGED PARTICLES IN A FLOW

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 53, No 6, Jun 85
(manuscript received 18 Jan 85) pp 1009-1010

[Article by N. I. Gamayunov]

[Abstract] Coagulation processes in water mediums are studied. With low values of the parameters of external fields, enlarged particles originate in the case where suspension is close to the threshold of coagulation. The external constant electric or magnetic field merely facilitates transition through this "threshold." The relative effect of processing in an electrical field is lower than in a magnetic. With low intensities of the fields an insignificant transfer of the counter ions contributes to a significant reduction of the Stern potential ψ_d because their sorption takes place according to Henry's law. With an increase of the field intensity sorption takes place according to Langmuir's law. In the process a large part of the ions goes back from the Stern layer into diffusion. The reason for such an anomaly is discussed in this article. The results are also presented of experiments with respect to the precipitation of clayish particles and their explanation on the basis of a proposed theory. Figures 1; references: 3 Russian.

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THERMAL CONDITIONS DURING START-UP OF UNDERGROUND PIPE LINES

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 55, No 6, Jun 85
(manuscript received 18 Jan 85) pp 1013-1014

[Article by A. V. Furman]

[Abstract] In connection with the design and reliable operation of underground systems for transportation of petroleum and petroleum products, a brief study is made of the thermal processes which take place in pipe lines at various stages of their operation and primarily during starting procedures. It is proposed to use the temperature shift of the petroleum flow in solving the energy

equations presented. The solutions obtained by this method assure precision of calculation of the heat loss and the temperature of the flow in underground main pipe lines. This makes it possible to recommend the approach given for an analysis of the thermal regimes of low-potential objects with a coefficient variable in time of the convective heat transfer and temperature medium.

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